Palmerston North Wastewater Best Practicable Option (BPO) Review

MCA Assessment

August 2021

Prepared for Palmerston North City Council by:

Stantec

QUALITY STATEMENT

Project Details

Project Manager:	Roger Hulme
Project Technical lead:	Melaina Voss / Jim Bradley

Report Details

Prepared by:	Melaina Voss	27/07/2021
Checked by:	Jim Bradley	4/08/2021
Reviewed by:	Simpson Grierson / Jim Bradley / Client	4/08/2021
Approved & Issued by:	Roger Hulme	5/08/2021

Executive Summary

This report has been prepared to assist the Council in identifying preferred options as part of the final Best Practicable Option (BPO) assessment. This assessment forms one of seven assessments being carried out, prior to confirming the BPO with Horizons Regional Council.

This Report documents the methodology and outputs of the Multi-Criteria Assessment (MCA) completed in November 2020 by the Council.

The MCA has been undertaken with the involvement of technical experts, Rangitāne o Manawatū and key stakeholders, who have advised the Council on options development and assessments throughout the Project and prepared the MCA comparative assessments (refer Appendix A).

Each of the 11 shortlisted options was assessed against the following 8 criteria:

- Public Health
- Natural Environment
- Maori Cultural Values
- Social and Community Considerations
- Financial Implications
- Technology and Infrastructure
- Resilience
- Growth & Economic Development

Following the agreement by decision makers and experts on the scores applied to each option, a total of 11 weighting scenarios were developed applied to the options scoring.

The outcome of the MCA process was inconclusive in terms of identifying a preferred group of options that could be considered for the next phase of the BPO Assessment process. Key feedback, messages and outcomes from the MCA process are captured in the MCA Outcomes Report, provided in Appendix A of this report.

On the basis that 5 scenarios tested are representative of the weighting scenarios considered at the MCA workshop, 5 have been included in the assessment process considered in this final phase of the Projects evaluation (Table 5). The scores for each scenario have been averaged to determine an overall score and rank for the 11 options.

The following table depicts the overall ranking of the options considered:

Option Description		Ranking
1	R2 (b)	5
2	R2 (b) (75% DWF land): 760 ha.	8
3	Dual R+L (b) (75% DWF to land): 870 ha.	4
4	L+R(a): 3760 ha	3
5	L+R(b): 2570 ha.	7
6	L+R(d-1) 80 m3/s trigger: 2000 ha.	6
7	L+R(d-2) 62 m3/s trigger: 1640 ha.	2
8	L+R(e-1) 80 m3/s trigger: 3640 ha.	10
9	L+R(e-2) 62 m3/s trigger: 3010 ha.	11
10	O+L: 1470 ha	9
11	O no land	1

CONTENTS

List of tables

List of figures

APPENDICES

1 Introduction

1.1 Overview of Assessment Process

In November 2020, the Council undertook a Multi-Criteria Assessment (MCA) of the short list options. The MCA was undertaken to help inform the process of determining the Best Practicable Option (BPO) for the Palmerston North City wastewater management solution. Figure 1 below illustrates how the MCA integrates with the other assessments and processes involved in determining the BPO.

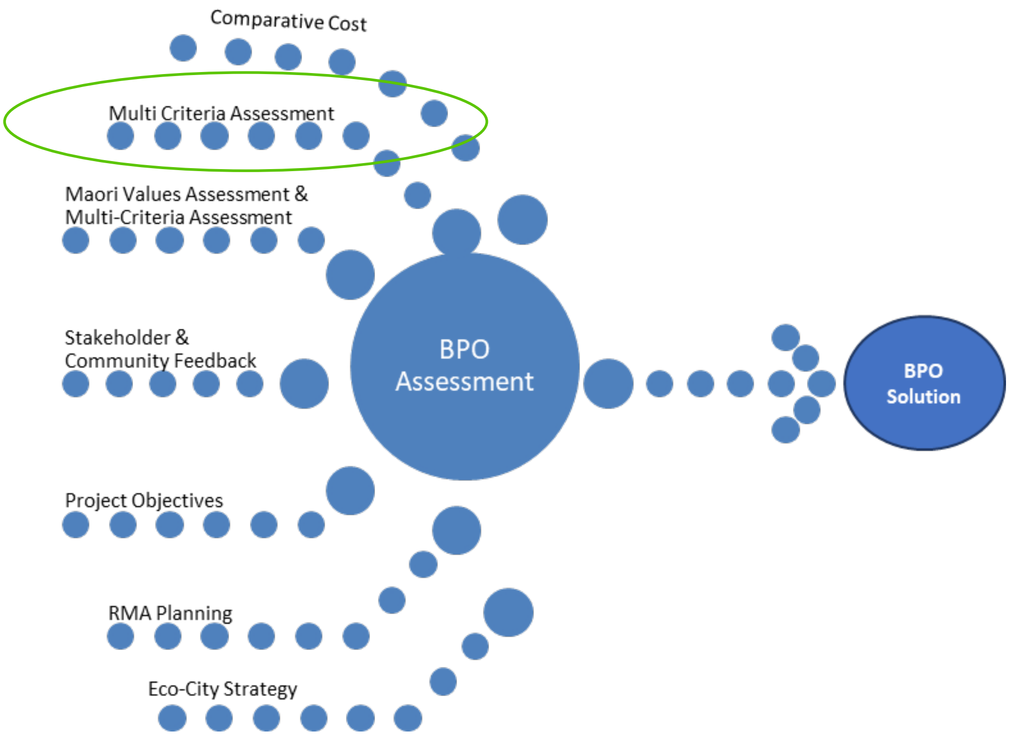


Figure 1 BPO Assessment Process

The MCA was completed between September 2020 and November 2020, including the preparation of comparative assessments across 8 criteria, prepared by technical experts and Iwi, followed by 2-days of workshops held in November. A full description of the MCA process and the outcome of the workshops is outlined in the 'MCA Outcomes Report', February 2021 provided in Appendix A of this Report.

1.2 Shortlist Options

The following table lists the shortlist options. Further details of the shortlist options are provided in the Shortlist Options Summary Report, May 2021. The Options considered at the MCA were based on the shortlist Options developed to September 2021. These options are consistent with the update report of May 2021.

Table 1 Options Description / Reference

Option No.	Option Summary Description
1	**R2(b) River discharge with Enhanced Treatment**
2	**R2(b) River discharge with Enhanced Treatment, 75% ADWF to land at low River flow**
3	**Dual R+L(b) Two River discharge points with 75% ADWF to Land at low River flow**
4	**L+R (a) 97% of the time to Land (inland)**
5	**L+R (b) 97% of the time to Land (coastal)**
6	**L+R (d-1) to Land <80m^3/s / 53% of the time to Land (inland)**
7	**L+R (d-2) to Land <62m^3/s / 43% of the time to Land (inland)**
8	**L+R (e-1) to Land <80m^3/s / 53% of the time to Land (coastal) TN = 35 mg/L**
9	**L+R (e-2) to Land <62m^3/s / 43% of the time to Land (coastal) TN = 35 mg/L**
10	**O+L / Ocean with Land (coastal)**
11	**Ocean discharge**

1.3 Supporting Project Information

The following technical document has been referred to in preparation of this Assessment Report:

- Wastewater BPO MCA Process Report and appended Comparative Assessment assessments (Appendix A), February 2021.

2 Methodology for this Assessment

2.1 Overview of the MCA

Multi-Criteria Analysis (MCA) is a tool to assist in decision making. For this project, the MCA methodology was used to provide an auditable and defensible evaluation of the six main short-listed options (a total of 11 options). A copy of the MCA Process Report is provided in Appendix A of this report. The report clearly outlines the methodology and process for completing the MCA between September and November of 2020.

In summary, an MCA process allows for rating of options, by assigning scores to a set of chosen criteria or attributes for the options under consideration. Criteria are typically chosen to cover key issues of concern and can cover tangible (e.g. cost) and intangible (e.g. opportunities and benefits) factors. The criteria scores are then combined, usually via a weighted sum, to arrive at a ranking of the options. The contribution that each criterion gives to the weighted sum is typically weighted to reflect the decision makers' judgement of the relative importance of the different criteria.

The scores are surrogates for measures of value for the criteria, allowing the effects of diverse criteria, with different units, to be combined in a single assessment. The weightings represent judgements about what is important in a particular situation or to a particular group of individuals.

A total of eight criteria were used to assess the options, these included:

Table 2 MCA Criteria Descriptions

Public Health	Degree of public exposure to health risks in treated wastewater (including through land application or re-use options)
Natural Environment	Potential adverse environmental effects on the receiving environment (including the Manawatū River), particularly in relation to water quality (including the matters listed in s107 (1) (c) to (g)), soils, aquatic ecology and terrestrial ecology
Māori Cultural Values	Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Māori, their cultures and traditions, with ancestral lands, waters, the sky father (Ranginui), sites, waahi tapu, taonga species and other taonga
Social and Community Considerations	Potential adverse effects on social and community values relating to amenity, recreation and food gathering

Financial implications	Comparative capital, operational, whole of life costs of the options. Where relevant to the option, assessment of this criterion includes consideration of land acquisition costs, capital gains and product net revenue.
Technology and infrastructure	Degree to which the option: • uses reliable and proven technology • can be staged • is able to be constructed • is able to be constructed within an appropriate timeframe • allows for resource recovery / beneficial re-use
Resilience	Degree to which the option is resilient to natural hazards and climate change and offers operational resilience.
Growth and Economic Development	Will the option support the population and economic growth anticipated for the City by Council?

2.2 Classification Process

For each of the eight criteria, scoring was undertaken by specialist technical advisors. This scoring was defined within a scale of 1 (extreme adverse effects) or 5 (minimal to no adverse effects). Definitions of these criteria and the alignment to the scale, are specific to the criteria and were determined by technical experts in their relative field of expertise. Iwi provided the cultural values assessment and, in some cases,, where applicable, stakeholders provided review of contribution to the assessments and scoring process. This is outlined in Section 3.2 of the MCA Outcomes Report (Appendix A). Table 3 sets out the banding/scoring used in the assessment as described in the MCA Outcomes Report.

Table 3 Scoring Criteria

Level of alignment	Score
No Adverse Effects	5
Low Adverse Effects	4
Medium/Moderate Adverse Effects	3
High Adverse Effects	2
Extreme Adverse Effects	1

2.3 Options Scoring

Scoring was initially assigned across all criteria by technical experts. At the MCA workshop, decision makers, stakeholders and technical experts discussed the scoring to reach a consensus. Table 4 below shows the agreed scoring applied to each of the 11 options against the 8 criteria (Refer Section 4.1 of the MCA Report, Appendix A). Commentary is also provided in Section 4.3 of the MCA Process Report, highlighting the key basis for scores applied to each option by experts and the workshop attendees.

Table 4 MCA Scoring of Options

Options	Option Description	Public health	Natural environment	Māori cultural values	Social & community	Financial implications	Technology & infrastructure	Resilience	Growth & economic development
1: R2(b)	River discharge with enhanced treatment	4	3	1	4	2.8	4	4	2
	River discharge with enhanced treatment, and a small % to land	3.5	3.5	1	3.5	2.1	4	3.5	2.5
2: Dual R + L	Two river discharge points and a small % to land	3.5	4	1	3.5	2.7	3	3.5	2.5
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	3	3.5	4	2.5	2.4	3	3	2
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	4	4	3	2.5	1.1	3	3	3
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	2	2.5	3	3	3.5	3
	55 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	3	2.5	2.8	3	3.5	3
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	2	2.5	3	2.5	2
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	2	2.2	3	2.5	2
6: Ocean	Ocean discharge, with a small % to land	3	4.5	1	2	1.9	2.5	3	4
	Ocean discharge	5	4	1	3.5	2.4	2.5	3.5	4

2.4 Weighting Scenarios

The need to assign different weightings to each criterion was agreed by Councillors and Stakeholders who attended the MCA workshop (November 2020). This was based on the consensus that all the criteria were not considered to be of equal importance.

A total of ten different weighting scenarios were developed at the workshop. Several weighting scenarios were considered, which are reflective of different groupings of the workshop participants namely Councillors and Stakeholders described as "Councillor Agreed" and the technical experts described as "Technical Group" (Table 5 below). Justification for the weightings was based on the agreement reached following discussion amongst workshop attendees and is included in Appendix A. Several common themes, priorities and concerns were identified, and these are documented in Section 4.3 of the MCA Outcomes Report (Appendix A). Table 5 outlines the weighting scenarios considered at the MCA.

Table 5 Weighting Scenarios from the MCA Workshop

	Weighting Scenarios	Public health	Natural environment	Māori cultural values	Social & community	Financial implications	Technology & infrastructure	Resilience	Growth & economic development	Explanation
1	Base workshop weighting scenario	**15.0%**	**15.0%**	**20.0%**	**15.0%**	**15.0%**	**0.0%**	**5.0%**	**15.0%**	**Scenarios 1-5 have been selected to progress to the Assessment process as they are considered to include the agreed weightings within the MCA workshop.**
2	Alternative workshop weighting scenario – Highest weighting to Social and Community	**10.0%**	**10.0%**	**15.0%**	**40.0%**	**10.0%**	**0.0%**	**5.0%**	**10.0%**	
3	Equal weight to all criterion	**12.5%**	**12.5%**	**12.5%**	**12.5%**	**12.5%**	**12.5%**	**12.5%**	**12.5%**	**Scenarios 6 – 12 are scenarios that are paralleled to Scenarios 1-5 and if included, would be perceived as 'double counting' within the assessment. It is noted a small % difference has minimal to no impact on the evaluation between criteria.**
4	No weight to financial implications	**17.6%**	**17.6%**	**23.5%**	**17.6%**	**0.0%**	**0.0%**	**5.9%**	**17.6%**	
5	50% weight to financial implications	**8.8%**	**8.8%**	**11.8%**	**8.8%**	**50.0%**	**0.0%**	**2.9%**	**8.8%**	
6	Councilor Agreed - Without Finance	**18.0%**	**20.0%**	**22.0%**	**12.0%**	**0.0%**	**0.0%**	**13.0%**	**15.0%**	Parallel to Option 4
7	Technical Group - Without Finance	**20.0%**	**20.0%**	**20.0%**	**20.0%**	**0.0%**	**5.0%**	**5.0%**	**10.0%**	Parallel to Option 4
8	Agreed Combined without finance	**20.0%**	**20.0%**	**20.0%**	**15.0%**	**0.0%**	**0.0%**	**10.0%**	**15.0%**	Parallel to Option 1
9	Agreed Combined with Finance	**15.0%**	**15.0%**	**20.0%**	**15.0%**	**15.0%**	**0.0%**	**5.0%**	**15.0%**	Parallel to Option 1
10	Agreed combined highest finance weight - Option 2	**10.0%**	**10.0%**	**15.0%**	**10.0%**	**50.0%**	**0.0%**	**0.0%**	**5.0%**	Parallel to Option 5
11	Councilor Agreed - With Finance	**15.0%**	**15.0%**	**20.0%**	**10.0%**	**15.0%**	**0.0%**	**10.0%**	**15.0%**	Parallel to Option 1
12	Technical Group - With Finance	**17.5%**	**17.5%**	**17.5%**	**17.5%**	**15.0%**	**3.8%**	**3.8%**	**7.5%**	Parallel to Option 1

3 Recommendation

3.1 Weighting Scenarios

Based on the observation that 5 of the scenarios were essentially equivalent to other scenarios tested at the workshop (Table 5), only 5 of the weighting scenarios have been carried forward into the overall MCA assessment to be considered in the final BPO assessment process. This avoids any duplication of scenarios.

Table 6 below shows the ranking achieved within the weighting scenarios and the outcome of the combined weighting scenarios. The overall average score is also listed and further breakdowns of scores is provided in the MCA Process Report (Appendix A). It should be highlighted that the options have scored relatively close together, which indicates there is no 'leading option' nor an option that there is a huge variation in option scoring. This is an underlying reason for undertaking multiple assessments in conjunction with the MCA, to assist Council in its decision-making process and maintain a robust evaluation process.

Table 6 Ranking of Options within applied weighting scenarios

		Rank of Option within Weighting Scenario's						
	Option	Base	Alternate	W/O Finance	50% Finance	Equal	**Average Score**	**Overall Rank**
1	R2 (b) (Level 4)	7	2	9	5	2	2.9	5
2	R2 (b) (75% DWF land): 760 ha. (Level 4)	8	4	7	7	5	2.8	8
3	Dual R+L (b) (75% DWF to land): 870 ha. (Level 2, TN=35)	6	3	5	4	4	2.9	4
4	L+R(a): 3760 ha. (Level 1)	3	6	3	6	7	3.0	3
5	L+R(b): 2570 ha. (Level 3, TN=10)	4	7	2	11	8	2.8	7
6	L+R(d-1) 80 m3/s trigger: 2000 ha. (Level 2, TN=35)	5	8	6	2	6	2.9	6
7	L+R(d-2) 62 m3/s trigger: 1640 ha. (Level 2, TN=35)	2	5	4	1	2	3.0	2
8	L+R(e-1) 80 m3/s trigger: 3640 ha. (Level 2, TN=35)	10	10	10	8	10	2.3	10
9	L+R(e-2) 62 m3/s trigger: 3010 ha. (Level 2, TN=35)	11	11	10	10	11	2.2	11
10	O+L: 1470 ha. (Level 1)	9	9	8	9	9	2.6	9
11	O no land (Level 1)	1	1	1	3	1	3.2	1

3.2 Recommended Options

Overall, the outcomes of the workshop are included in the MCA Report provided in Appendix A of this Report. In summary, there is limited direction from the output of the MCA to enable the Council to determine a preferred option through the various weighting scenarios.

Based on the methodology described in Section 3.1 above, Table 7 below shows the ranked order of options based on the average score provided across the range of weighting scenarios (Table 6).

Table 7 Options ranking across 5 weighting scenarios from the MCA

	Option Description	**Treatment Level**	**Combined Ranking**
1	R2(b) River discharge with Enhanced Treatment	4	5
2	R2(b) River discharge with Enhanced Treatment, 75% ADWF to land at low River flow	4	8
3	Dual R+L(b) Two River discharge points with 75% ADWF to Land at low River flow	2	4
4	L+R (a) 97% of the time to Land (inland)	1	3
5	L+R (b) 97% of the time to Land (coastal)	3	7
6	L+R (d-1) to Land <80m³/s / 53% of the time to Land (inland)	2	6
7	L+R (d-2) to Land <62m³/s / 43% of the time to Land (inland)	2	2
8	L+R (e-1) to Land <80m³/s / 53% of the time to Land (coastal) TN = 35 mg/L	2	10
9	L+R (e-2) to Land <62m³/s / 43% of the time to Land (coastal) TN = 35 mg/L	2	11
10	O+L / Ocean with Land (coastal)	1	9
11	Ocean discharge	1	1

It is recommended that all options are considered in conjunction with the wider assessment approach before being recommended for assessment through the BPO Criteria. This will be determined in the BPO Recommendation Report

Appendix 1: MCA Outcomes Report February 2021

PALMERSTON NORTH WASTEWATER
BEST PRACTICABLE OPTION (BPO) REVIEW

Alternative Assessment – MCA Process Report
10 FEBRUARY 2021

Prepared for Palmerston North City Council with involvement of:

Stantec

PATTLE DELAMORE PARTNERS LTD

River Lake

Aquanet Consulting Limited

JUST ADD LIME

PROJECT DETAILS

Project Manager:	Melaina Voss
Project Sponsor:	Robert van Bentum

Report Details

Prepared by:	Melaina Voss / Jim Bradley	29/01/2021
Reviewed by:	Robert van Bentum	1/02/2021
Approved & Issued by:	Robert van Bentum	2/02/2021

CONTENTS

List of tables

List of figures

APPENDICES

Executive Summary

Palmerston North City Council (the Council) currently treats and discharges the city's wastewater at the Totara Road Wastewater Treatment Plant into the Manawatu River. The wastewater discharge was consented by Horizons Regional Council in 2006 expires 2028. In 2013, Horizons Regional Council (as the consenting authority), determined the wastewater discharge had more than minor effects on the Manawatu River. In 2013, the Council agreed with Horizons Regional Council to pursue a new resource consent for the Best Practicable Option (BPO) by June 2022. A Preferred Option 'BPO' must be determined by the Council before 1 June 2021.

In early 2017 the Council commenced the process of identifying and determining the BPO. A range of technical assessments and decision making, or evaluation tools have been used to assist Council with making its decision. The process is explained visually in Figure 1 of this Report, however in summary a phased approach has been followed to narrow potential options from 36 (long list options) to 6 shortlisted options. Significant work has been undertaken by the Council's technical experts to refine the shortlist options since they were identified in June 2019. This development work was necessary to inform and undertake a Multi-Criteria Assessment to robustly review the short list options and identify one or more preferred options. The MCA process is a decision-making tool commonly used and accepted in Resource Management Act (RMA) consenting processes for projects such as this BPO Project.

Following completion of the technical work, in November 2020 the Council undertook the Multi-Criteria Assessment phase of the options selection process (refer Figure 1). This report summarises the MCA process and outlines the framework adopted by Council in undertaking this MCA assessment (refer Figure 2). This report also provides recommended next steps within the broader assessment process (refer Figure 3 below).

The MCA process was carried out over several days of workshops summarised:

Workshop Description	Purpose
MCA Briefings: October 2020	- Attended by Technical Experts only: To work with all attendees on understanding the options, workshop format and purpose of the MCA evaluation workshop. - Attended by Councillors and Stakeholders only: To brief the Councillors and Stakeholders on the MCA workshop format and pre-reading material.
MCA Evaluation: 9 & 10 November 2020	Attended by both technical experts, Councillors, Council Officers and Stakeholders: To agree criteria scoring and undertake weighting of the criteria to determine overall scoring of options. The objective of this process was to identify if there are potential options for elimination and prioritisation in the broader assessment process.

Attendance at the various workshops has included expert technical advisors, key stakeholders and decision makers. A full list of participants is included in Appendix B and in summary includes:

- Technical experts, who also prepared the comparative assessments for the MCA.
- Limited number of Councillors and Executive Leadership Team.

- Project Steering Group members for the BPO Project.
- Rangitane o Manawatu and Muaopoko Iwi representatives
- Key stakeholder representatives from Federated Farmers, Environment Network Manawatu & Ministry of Health.
- An external facilitator; and
- Council staff to assist in formalities of the day.

In summary, the MCA process confirmed the following for the Council:

- No single option was identified out of the MCA assessment process as a preferred BPO. Sensitivity testing involving changes to the weightings of the criteria confirmed that scoring changes of less than 0.3 did not change the top-ranking options.
- As no one option emerged as being preferred across a range of weighting scenarios, the additional assessments included within the broader evaluations (MCA with Iwi and further round of engagement and consultation) will be important to guiding Council's selection of the BPO
- From the MCA Option 6 'Ocean discharge' ranked the highest with Option 1 'River Discharge' and Option 4 '45% discharge to land inland land /Fluvial soils', ranked closely behind.
- While the MCA process was not conclusive, several options emerged as consistently scoring well across a range of criteria and weightings. These options are considered most appropriate to be considered in the next stage of the assessment process. These options include:
    - Option 1 - A majority of the treated wastewater being discharged to the Manawatu River with substantially high treatment and a portion to land. This will closely meet One Plan targets. While this option was not well supported by Iwi, considerations of a higher standard of treatment were proposed by several key stakeholders and decision makers.
    - Option 4 - A 45% discharge to inland fluvial soils. However, this option should seek to reduce the land area requirements and providing a high standard of treatment 55% of the time for the River discharge component.
    - Option 6 - A Ocean discharge. This option scored well due to its ability to provide a regional or sub-regional scheme. Feedback from the workshop suggested that a higher level of treatment may need to be considered than currently proposed to allay concerns of Iwi and other stakeholder feedback.
- During the workshop, some agreed positions emerged among the workshop participants that warrant further investigation during the next phase of the process, including:
    - The natural environment is highly valued by the Council. Attendees supported selection of higher treatment standards for discharges to river or ocean than proposed for some options presented at the MCA. Providing a higher level of treatment would represent a departure from the premise underpinning option development to date which was that treatment should be sufficient to mitigate effects for the receiving environment given this will be necessary to gain a consent under One Plan.
    - Options requiring significant land areas (2,500ha to 3,500ha) i.e Option 3 '97% to land', would be considered problematic and likely not feasible due to the significant quantity of. Class 1 soils required. The consumption of significant areas of Class 1 agricultural soils and areas suitable for urban development was considered a significant disbenefit. There was strong support for exploring options

that reduced land areas and provided higher treatment as a mitigation strategy to negative impacts on productive land capacity.

- Concern that the true costs of large areas of land purchase in the region, along with the complexity of purchasing such large areas, have been insufficiently assessed to date. Further work was recommended by suitably qualified property experts to confirm the true cost of options requiring a land component.
- Concern that the MCA process did not understand or adequately weight the effects on individuals and the community of large-scale land irrigation systems, therefore a pre-cautionary approach was preferred when considering land-based options.
- Concern that the extent of social impacts for each option, particularly land-based options, is not fully understood at this stage of the process. In particular Options 2, 3 and 4, which requires more than 1,000ha and up to 3,500ha of land, may have substantial effects and therefore confidence is generally low in terms of scoring.
- Concern that the information presented in respect of the ocean discharge options, including the treatment standards and effects of a wastewater discharge of this volume and quality was not adequate. This was reinforced by the absence of an ocean expert at the workshop to provide context around these options and the expert scoring.

The participants requested that additional technical work should be undertaken prior to deciding on the BPO and to inform the wider assessment process (refer Figure 3). The information would assist Council with refining shortlist options and provide stakeholders and decision makers with greater confidence in respect to effects on the river and ocean, social and community and costs of the options, as well as mitigation of potential adverse effects.

Work packages identified from the MCA as being able to provide additional information to inform the next steps in the assessment process, included:

- Updated land costs to provide more robust total costs for options including land.
- Revision of the target treatment standards for each option with consideration of targeting higher treatment standards being those required to meet minimum One Plan standards
- Assessment of alternative land use and revenue streams particularly for land-based options to improve the robustness of option costs.
- Modelling of the River to identify if a ‘staged ‘option could be developed for staged achievement of compliance standards to all for gradual acquisition of land and/or implementation of treatment improvements.
- Reconfirm the growth assumptions over the 30- and 50-year period including the assumed contributions from industry and particularly wet industry. This work needs to identify the growth rates being considered for consent i.e low, medium and high and align with the Councils growth strategy under the District Plan.
- Continue to explore a region wide solution in the context of the national water reform agenda and recognition that a shared solution would meet Councils growth aspirations for residential and industry, as well as provide for wastewater from neighbouring Councils. This would require assessment for each of the shortlist options of how additional flows and loads could be accommodated.
- Further work on the ocean environmental effects of the ocean discharge options including an update of the experience of ocean outfalls in a New Zealand context which comparable to the option being considered by Council.

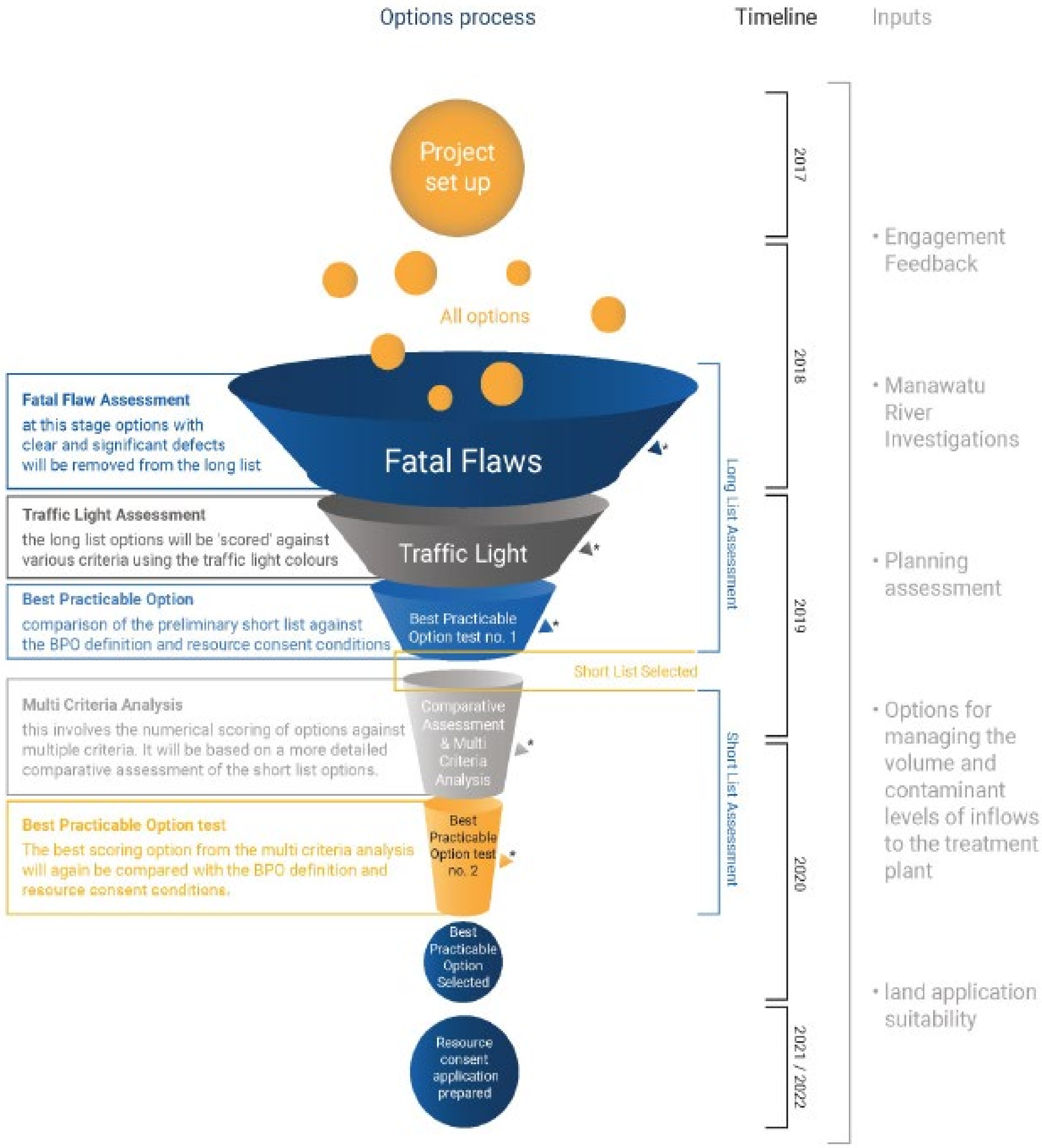
The outcome of the MCA process to date has highlighted that while Council is not yet able to confirm a preferred option, there were several options which scored consistently well across a range of criteria and weightings. Not with standing this it is recommended that:

- Completion of the remaining assessments (refer Figure 3) is necessary to guide Council in its decision-making process to select a Best Practicable Option by June 2021.
- Further consultation and engagement process with stakeholders and the community is necessary, in conjunction with the Long-Term Plan process, to provide Council with further feedback on community and stakeholder preference.
- Although there was no clear preferred option, it is recommended that Council highlight the smaller number of options which rank more highly and seek specific feedback on clear trade-offs.
- Given the additional information which has been assembled for each of the short list options, consultation and engagement should include information on all options, with more emphasis on the higher-ranking group.
- Before the consultation process is commenced, it is recommended that the further technical work identified out of the MCA process is completed. This will further assist Council in framing the consultation strategy and assessment process being undertaken.

1 Introduction

1.1 Background to the Assessment Process

In early 2017 the Council embarked on the journey of identifying a BPO for the cities wastewater management. The decision-making process carried out since this time has been confirmed through a series of assessment tools, workshops and technical evaluations. The methodology adopted for the Project is outlined in Figure 1.



To date, the Council has successfully delivered the Fatal Flaw Assessment, Traffic Light Assessment and Best Practicable Options Assessment (on the proposed shortlist).

Figure 1 BPO Assessment Methodology

The Multi-Criteria Assessment (MCA) forms one of a number of assessments determined as part of the 'broader assessment methodology' being adopted to determine a BPO (refer Section 1.2 below). A key determinant for the broader methodology has been developed under the conditions on the existing wastewater discharge resource consent. Under condition 23B of that consent, PNCC is required to '…*determine the best practicable option for treating and disposing of wastewater (including land disposal systems).*'. In defining 'best practicable option' condition 23B adopts the definition from the Resource Management Act 1991 (RMA) but adds detail that has specific relevance to the current discharge from PNCC's wastewater treatment plant (WWTP). In this regard Condition 23B defines the 'best practicable option' as:

- *the best method for preventing or minimising the adverse effects on the environment of that discharge having regard, among other things, to -*

  (i) The nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and

  (ii) The financial implications, and the effects on the environment, of that option when compared with other options; and

  (iii) The current state of technical knowledge and the likelihood that the option can be successfully applied.

- The Best Practicable Option shall be directed at preventing or minimising any adverse effects of the discharge on the life supporting capacity of the Manawatu River and in particular at minimising any adverse effects in relation to each of the following:

  (i) Growth of cyanobacteria and excessive periphyton;

  (ii) Changes to the structure and/or composition of macro-invertebrate communities; and

  (iii) The migration and habitat of trout and native fish.

- *In determining the Best Practicable Option, the Permit Holder shall have regard to minimising the frequency, magnitude and duration of any exceedances of applicable standards, limits or targets in National Policy Statements, National Environmental Standards and any relevant Regional Plan, caused by the discharge and shall take into account the principles in Part 2 of the Resource Management Act 1991, and the considerations contained in sections 104, 105 and 107 of that Act.*

1.2 Purpose of the MCA Process

Multi-Criteria Analysis (**MCA**) is a tool to assist in decision making. It is used in a wide range of infrastructure projects, such as wastewater schemes, roading alignment selection, water supply options, water demand management and powerline route selection. Multi-Criteria Analysis is a well-accepted tool for decision makers and has been tested through various large scale Environment Court hearings.

The International Infrastructure Management Manual 2011, as adopted by local authorities in New Zealand, describes MCA as "*a decision technique that considers more than one criterion (not just monetary units). It is commonly used where the benefits and costs are more difficult to accurately define and are both quantitative and qualitative in nature*".

For this project, the MCA methodology was used to provide an auditable and defensible evaluation of the six main short-listed options. Figure 2 below illustrates the steps taken by the Council's technical team to progress the MCA process to completion.

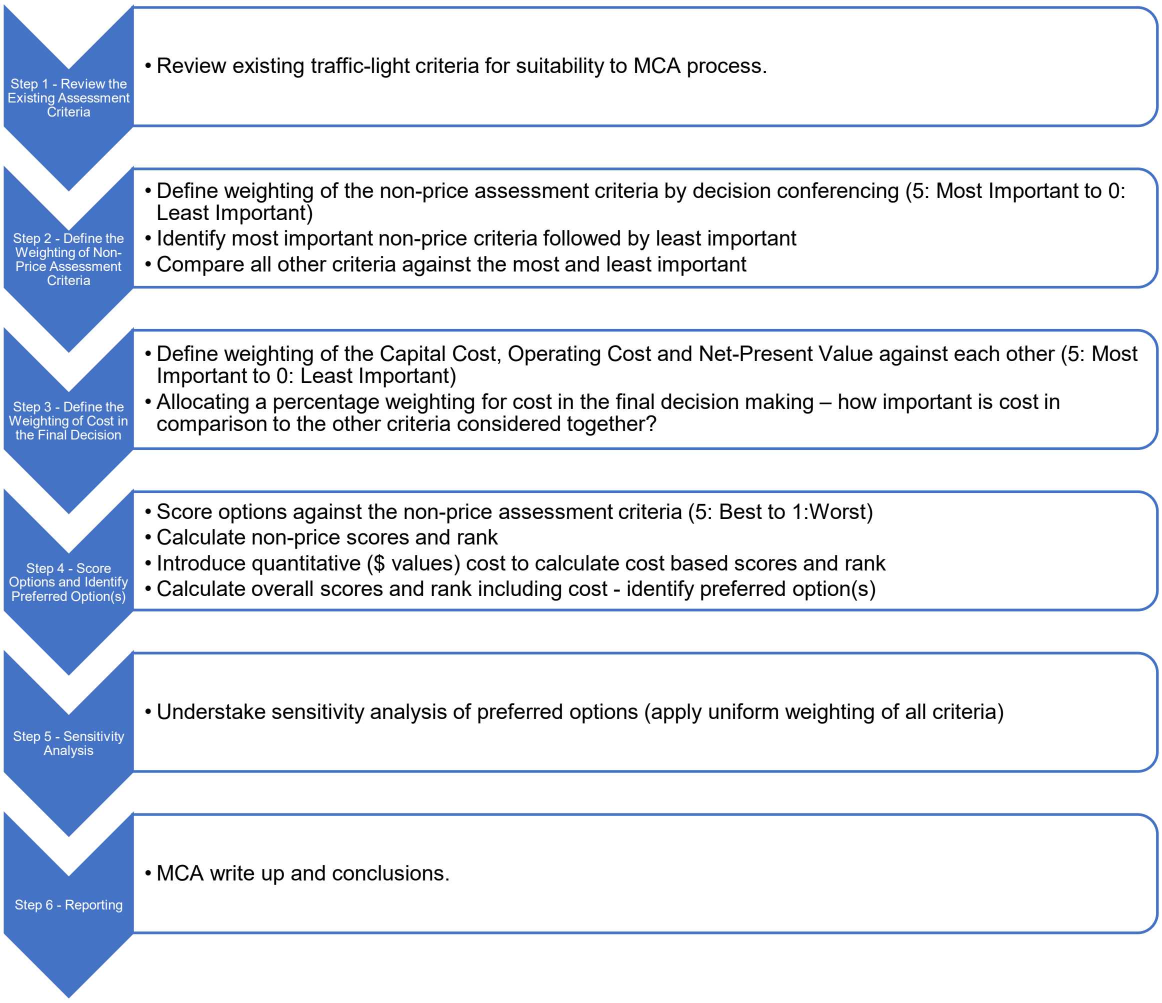


Figure 2 MCA process

Decisions are guided by rating the options, which is achieved by assigning scores to a set of chosen criteria or attributes of the options considered. Criteria are typically chosen to cover all issues of concern and can cover tangible (e.g. cost) and intangible (e.g. opportunities and benefits) factors. The criteria scores are combined in some way (usually a weighted sum) to rank the options. The contribution that each criterion gives to the sum of scores for an option is weighted to reflect the decision makers' judgement of the relative importance of the different criteria.

The scores are surrogates for measures of value for the criteria, allowing the effects of diverse criteria, with different units, to be combined. The weightings represent judgements about what is important in a particular situation or to a particular group of individuals.

The method used to derive the MCA weightings and scores has been considered with the involvement of an independent facilitator (Sara Dennis of Just Add Lime).

The criteria used in the fatal flaw and traffic lighting assessment were revisited, redefined, and fine-tuned by the technical team and endorsed by the Project Steering Group (refer *BPO Traffic Light Assessment Report* 2019, prepared by Stantec).

1.3 Broader Assessment Approach

To meet the requirements of Condition 23B of the existing Resource Consent, it is proposed that multiple assessment tools are used. The information gained from these assessment tools will be brought together and aligned with the requirements of condition 23B using an assessment matrix. The purpose of this assessment matrix is to provide PNCC with an overall picture of the merits of each option to assist in determining the BPO. This broad assessment approach is illustrated in Figure 3.

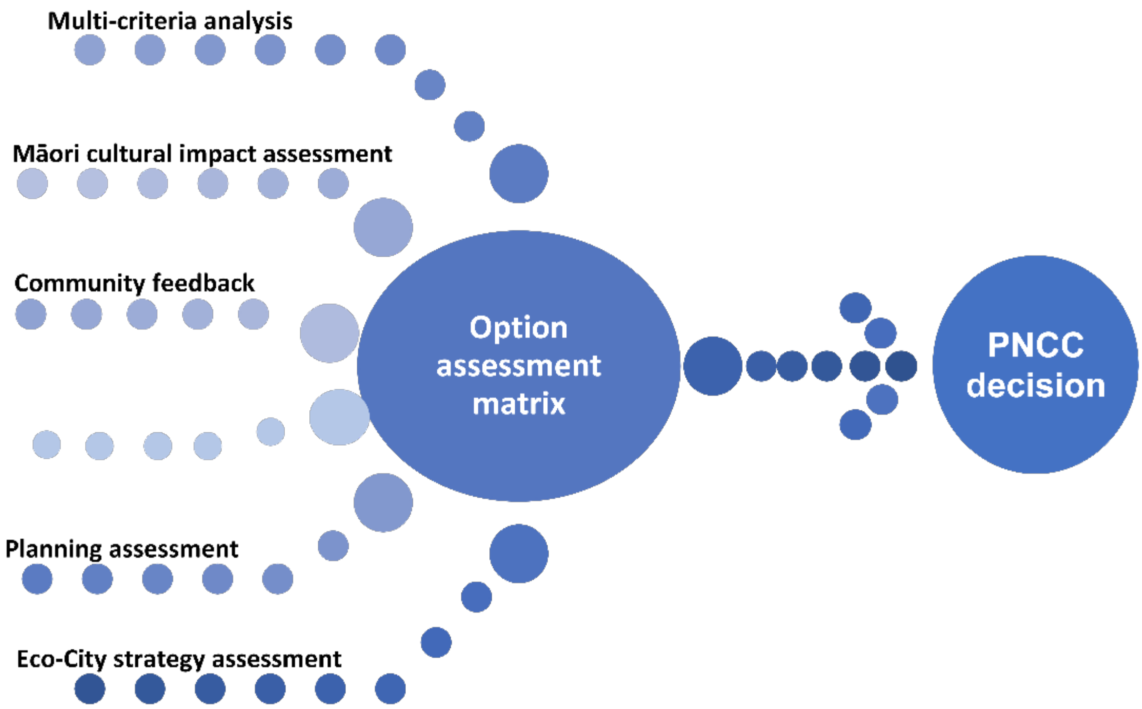


Figure 3 Broad assessment approach

This report describes the process and outcomes of the MCA process, within the context of this broader assessment. An Alternatives Assessment Report will be prepared encompassing the outcomes of each of the assessment tools and consultation process, identified in refer Figure 3.

1.4 Project Vision, Objectives & Options Assessment Principles

The BPO Review's vision, objectives and assessment principles are key elements that guide the whole project. These were established in earlier phases of the project and should inform not only PNCC's decision on the best practicable option, but also its decision on the short list assessment approach. For reference, these are set out below:

Project Vision

Management of the City's wastewater which enables growth, protects and enhances the environment and contributes to improving the health and mauri of the Manawatū River.

Project Objectives

A best practicable option wastewater management solution that is developed in partnership with Rangitāne o Manawatū which:

1. *Protects public health and minimises public health risks*
2. *Minimises adverse environmental effects on air, land and water*
3. *Is sustainable, enduring, and resilient*
4. *Contributes to improving the health and mauri of the Manawatū River*
5. *Takes an integrated approach to the management of the Manawatū River Catchment including understanding cumulative effects*
6. *Enhances peoples use and enjoyment of the Manawatū River*
7. *Is affordable and cost effective*
8. *Minimises whole of life carbon emissions and optimises resource recovery*
9. *Is innovative while being evidence based*
10. *Facilitates long term growth and economic development*
11. *Is developed with the active engagement of the community and key stakeholders.*

Assessment principles

The assessment approach should be:

- *Fit for purpose, i.e. meets RMA requirements and best practice*
- *Simple and readily replicable*
- *Transparent and easily understood*
- *Well documented, with a clear auditable trail*
- *Evidence based*
- *Collaborative.*

The project objectives have been used in determining the assessment criteria used in the MCA process.

1.5 Technical Input

The following experts have been involved in the MCA process, including preparation of the comparative assessment and presenting at the MCA workshop. Note that in all cases, a majority of the assessments have been prepared with more than one author. Refer to the comparative assessments in Appendix 1 for further details. During the workshops, only one expert in their field was asked to attend.

Public Health - Jim Bradley (Stantec)

Resilience, Technology & infrastructure, Financial - Anna Bridgman (Stantec)

Groundwater - Aslan Perwick (PDP)

Freshwater quality and ecology – Olivier Ausseil (Aquanet) & Keith Hamill (Riverlake)

Social and community - Julie Boucher (Just Add Lime)

RMA Planning advice and guidance to MCA process - Paula Hunter (Stantec)

1.6 Purpose of this Report

This report summarises the Multi Criteria Analysis (MCA) completed to determine the preferred options for consultation in early 2021. This report has been prepared with references to project documents and record, including:

- *BPO Shortlist Options Summary Report, September 2020*
- *BPO MCA Briefing Report, October 2020* (Appendix 1)
- *BPO MCA Workshop material and meeting record notes* (Appendix 2)

2 The Short List Options

Table 1 below summarises the short list of options, which is made up of 5 options. For detailed information supporting each of the shortlist options refer to the *Shortlist Options Summary Report, September 2020*. This document was used by each of the comparative assessment authors to undertake their MCA assessments.

As an overview, each option represents an alternative approach to address the known adverse effects of the current wastewater discharge to the Manawatū River. For example, option 1 would involve the use of significantly enhanced treatment technology to produce a high-quality treated wastewater, as well as a wetland, before discharging to the Manawatū River. Alternatively, option 3 would involve applying nearly all of the wastewater to land at either an inland (fluvial soil) or ocean (sand country) location.

Options 1, 3, 4, and 6 all have multiple variants. Across all options 11 variants have been brought forward to the MCA workshop. Each of these variants is assessed in the comparative assessments attached to this report. It is acknowledged that an almost infinite number of variants could be identified. However, for practical reasons the number of variants assessed through the MCA has been limited to 11. Once the BPO has been selected it is anticipated that further refinement and optimisation of the option will occur, together with mitigation measures for (any) residual adverse effects. This will occur prior to the lodgement of the necessary resource consent applications.

Finally, it is noted that former Option 5, which was a mixed ground water and land application option, has been removed from the short list. The option has been removed because as it had been refined over the past 12 months, it had become evident that the option involved numerous significant negatives (such as high treatment requirements, relatively direct discharge to freshwater and large land areas) and did not present any benefits relative to the other options.

Table 1: Short list of options

Option	Description of Variant
1	River discharge with enhanced treatment
	River discharge with enhanced treatment, and a small % to land
2	Two river discharge points and a small % to land
3	97 % applied to an inland land application site and a discharge to river in exceptional circumstances
	97 % applied to a ocean land application site and a discharge to river in exceptional circumstances
4	45 % applied to an inland land application site and a river discharge for the remainder of the time
	55 % applied to an inland land application site and a river discharge for the remainder of the time
	45 % applied to a ocean land application site and a river discharge for the remainder of the time
	55 % applied to a ocean land application site and a river discharge for the remainder of the time
6	Ocean discharge, with a small % to land
	Ocean discharge

3 Evaluation of Assessment Criteria

This section outlines the evaluations undertaken by the project team. These assessments were presented at the MCA workshop and are included in Appendix 1 of this Report.

As with the Traffic Light Assessment phase of the Project and consistent with carrying out an MCA process, this MCA was undertaken through a workshop process. Follow up review by the technical team, to ensure further outcomes of the MCA were being addressed, has also been undertaken. The outcomes of the MCA workshop and conclusion are provided later in this Report.

3.1 Summary Criteria

The first step in the process was endorsement by the Council for Assessment Criteria. Based on the Traffic Light Assessment process completed in 2019, the Project Steering Group supported the ongoing use of those criteria in the MCA process. There are benefits to utilising these criteria, which includes: consistency in the evaluation, broad range of applied criteria, covers the range of agreed project objectives well and can be applied to the Resource Management Part 2 assessment as set out in Section 4.4 of this Report.

The criteria were however refined from the earlier process and are outline in Table 2 below.

Table 2: Traffic Light Criteria

Criteria	Description
Public Health	Degree of public exposure to health risks in treated wastewater (including through land application or re-use options)
Natural Environment	Potential adverse environmental effects on the receiving environment (including the Manawatū River), particularly in relation to water quality (including the matters listed in s107 (1) (c) to (g)), soils, aquatic ecology and terrestrial ecology
Māori Cultural Values	Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Māori, their cultures and traditions, with ancestral lands, waters, the sky father (Ranginui), sites, waahi tapu, taonga species and other taonga
Social and Community Considerations	Potential adverse effects on social and community values relating to amenity, recreation and food gathering
Financial implications	Comparative capital, operational, whole of life costs of the options. Where relevant to the option, assessment of this criterion includes consideration of land acquisition costs, capital gains and product net revenue.
Technology and infrastructure	Degree to which the option: • uses reliable and proven technology • can be staged • is able to be constructed • is able to be constructed within an appropriate timeframe • allows for resource recovery / beneficial re-use
Resilience	Degree to which the option is resilient to natural hazards and climate change and offers operational resilience.
Growth and Economic Development	Will the option support the population and economic growth anticipated for the City by Council?

3.2 Criterion Scoring

In preparation of the workshop held in November, the experts were asked to consider the scoring each option (in their specialist area only) against each criterion. The higher the score the better the option was considered to be for a particular criterion (5: Best to 1: Worst).

At the MCA workshop, the scores were brought together into an interactive spreadsheet and discussed amongst the attendees. This discussion was necessary to draw out any concerns or issues decision makers may have. It was then facilitated to reach an agreed score by both technical experts and the decision makers in Day 1 of the workshop and prior to any weighting being undertaken. The following table outlines how each of the criterion was scored. Detailed comparative assessments are provided for in Appendix 1 of this Report for reference.

Table 3 Criterion Scoring Overview

Criterion	Description	1	2	3	4	5
Public Health	Degree of health risk to the public because of exposure to treated wastewater (including through land application)	Extreme	High	Medium	Low	None
Natural environment	Potential adverse environmental effects on the receiving environment (including the Manawatū River), particularly in relation to water quality (including the matters listed in s107 (1) (c) to (g)), soils and aquatic ecology.	Very High adverse effects. Major loss or alteration of baseline conditions (in absence of current discharge)	High adverse effect. Major alteration of baseline conditions (in absence of current discharge)	Moderate adverse effects. Alteration to existing baseline conditions. Generally, effects are moderate but acceptable in the context of magnitude, spatial scale, duration, and frequency.	Low adverse effects. Minor shift from baseline conditions or ecological populations (in absence of current discharge).	Very Low adverse effects. Very slight change in baseline conditions.
Māori Cultural Values	Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Māori, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga	Destruction of Rangitāne culture, connections and kaitiakitanga. Critical effect on Rangitāne o Manawatū	Significant effect or impact on all aspects of Rangitāne Mana, Toanga, Atua and natural resources	Major impact on all aspects of Rangitāne significant sites and natural resources	Minimal impact on Rangitāne significant sites and natural resources	Minimal to no effect on Rangitāne o Manawatū
Social and Community Considerations	Significance of potential social effects based on the gravity, distributive equity, the need for land acquisition and degree of permanence of land use change, and public support for the option	Severe	Major	Moderate	Minor	Insignificant
Financial implications		Financial implication scores have been calculated using a formula explained in the report.				
Technology and infrastructure	Degree to which the option: • can be staged • is able to be constructed and operational within 5 years of the commencement of the consent • allows for resource recovery / beneficial re-use • infrastructure can be up-scaled, prior to and post initial construction, to accommodate a sub-regional scheme • involves Operational Complexity • involves Operational Risk	Low degree of alignment with sub-criteria and/or High Operational Complexity and Risk	Low – Medium degree of alignment with sub-criteria and/or Medium-High Operational Complexity and Risk	Medium degree of alignment with sub-criteria and/or Medium Operational Complexity and Risk	Medium – High degree of alignment with sub-criteria and/or Low-Medium Operational Complexity and Risk	High degree of alignment with sub-criteria and/or Low Operational Complexity and Risk
Resilience	Degree to which the option is resilient to • natural hazards • climate change	**Low degree of resilience**	**Low – Medium degree of resilience**	**Medium degree of resilience**	**Medium – High degree of resilience**	**High degree of resilience**
Growth & Economic Development	The degree to which the options will: • Support the population and economic growth anticipated for the City by Council? • Support / restrict further up-scaling to accommodate a sub-regional scheme?	**Low degree of**	**Low – Medium degree**	**Medium degree**	**Medium – High degree**	**High degree**

3.3 Applied Scores

Table 4 below presents the scoring made by technical experts who prepared the comparative assessments (refer Appendix 1). The scored represent the work undertaken prior to MCA workshop and do not show any potential changes, as there were made at the workshop with decision makers and are represented in Table 5.

Table 4 Preliminary Scoring as recommended by experts only

Options	Option Description	Public health	Natural environment	Māori cultural values	Social & community	Financial implications	Technology & infrastructure	Resilience	Growth & economic development	TOTAL AVERAGE (No Weight)
1: R2(b)	River discharge with enhanced treatment	4	3	1	2	2.8	4	4	2	2.7
	River discharge with enhanced treatment, and a small % to land	2.5	3.5	1	1	2.1	4	3	2.5	2.4
2: Dual R + L	Two river discharge points and a small % to land	4	4	1	1	2.7	3	3.5	2.5	2.6
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	3	3.5	4	1	2.4	3	3	2	2.7
	97 % applied to an ocean land application site and a discharge to river in exceptional circumstances	4	4	3	1	1.1	3	3	3	2.5
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	2	1	3	3	3.5	3	2.8
	55 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	3	1	2.8	3	3.5	3	2.9
	45 % applied to an ocean land application site and a river discharge for the remainder of the time	2	3	2	1	2.5	3	2.5	2	2.4
	55 % applied to an ocean land application site and a river discharge for the remainder of the time	2	3	2	1	2.2	3	2.5	2	2.5
6: Ocean	Ocean discharge, with a small % to land	2.5	4.5	1	1	1.9	2.5	3	4	2.6
	Ocean discharge	5	4	1	2	2.4	2.5	3.5	4	3

4 MCA Workshop

The workshop involved relevant experts such as engineers (land discharge, irrigation, wastewater treatment design and public health), environmental scientists with expertise in science and freshwater ecology, land use and strategic planners, maori cultural values (Rangitane as mana whenua), and social impacts specialists. A copy of the workshop briefing material is provided in Appendix 1 of this Report.

The main workshop was attended by whom Council considered decision makers and key stakeholder representatives. The full list of attendees is included in Appendix C (workshop notes), however in summary did include: Councillors, Rangitane o Manawatu and Muaopoko representatives, PSG members, Councils Executive Leadership Team, Stakeholder representatives from the Regional District Health Board, Federated Farmers and Environment Network Manawatu.

The MCA was completed over 2 days, with preparatory days prior to this, made up of the following:

- Preparation Day 1: Meeting of technical experts only to present the shortlist options (briefing material) and identify any gaps in information needed to complete comparative assessments.

- Preparation Day 2: Meeting of Councillors and Stakeholders (decision makers) to present the options an provide guidance on the MCA workshop process.

- MCA Workshop Days 1 & 2: MCA Assessment workshop attended by technical experts and decision makers. The first of the two days involved the presentation of scoring and working through each options collective scoring results. The second day involved the weighting of criteria and completing sensitivity scoring as determined by the attendees for comparison purposes only.

The MCA workshop began with a discussion of each of the technical assessments that were completed with relevant scoring against the options being assessed. This was also an opportunity to discuss anomalies in this scoring or information that had been circulated prior to the meeting. The scoring was then confirmed or refined by the group to ensure they were representative of issues likely to be of concern.

Next each expert presented information on the various aspects and for which they were responsible and for. This was followed by a group discussion on each of the aspects and an assignment of scores according to the relative importance of that aspect for each section of each option.

4.1 Agreed Scoring

Tab le 5 below shows the scoring allocated and agreed at the workshop with decision makers on Day 1 (9th November 2020). Note that the red numbers depict where scoring was changed at the workshop in red. The basis for these changes is captured in the commentary provided in Section 4.2 below.

Table 5 MCA Agreed Scoring undertaken on 9-10 November 2020

Options	Option Description	Public health	Natural environment	Māori cultural values	Social & community	Financial implications	Technology & infrastructure	Resilience	Growth & economic development
1: R2(b)	River discharge with enhanced treatment	4	3	1	4	2.8	4	4	2
	River discharge with enhanced treatment, and a small % to land	3.5	3.5	1	3.5	2.1	4	3.5	2.5
2: Dual R + L	Two river discharge points and a small % to land	3.5	4	1	3.5	2.7	3	3.5	2.5
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	3	3.5	4	2.5	2.4	3	3	2
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	4	4	3	2.5	1.1	3	3	3
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	2	2.5	3	3	3.5	3

Options	Option Description	Public health	Natural environment	Māori cultural values	Social & community	Financial implications	Technology & infrastructure	Resilience	Growth & economic development
	55 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	3	2.5	2.8	3	3.5	3
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	2	2.5	3	2.5	2
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	2	2.2	3	2.5	2
6: Ocean	Ocean discharge, with a small % to land	3	4.5	1	2	1.9	2.5	3	4
	Ocean discharge	5	4	1	3.5	2.4	2.5	3.5	4
Red font is used to show any changes agreed from the specialist recommendations. This will aid with transparency.									

4.2 Commentary

Following the presentation of scores by experts, the workshop attendees were broken into 5 groups. The groups were made up of councillors, experts, council officers to ensure there was availability of technical support alongside decision makers. Representatives of each group were then asked to present the collective findings from each Option for consideration by the wider group. Table 6 below, notes key discussion points with a copy of the workshop notes provided in Appendix 2 of this Report.

Table 6 Workshop Commentary on each option

Option Reference		Commentary / Discussion
1. R2(b)	River Discharge with enhanced treatment	There are further treatment enhancements available to Council with this option in time ie reverse osmosis. However, this was fatally flawed in the long list because of costs. Land based schemes have flooding risks and an assumption the land would be in a floodplain, making the options less resilient overall. Variant 1b changed scoring to 3.5 (less resilient that Option 1).
	River Discharge with enhanced treatment with a small portion to land	The differences in the public health scores are due to the mitigation put in place for land treatment e.g. buffers, access restrictions. Jim Bradley went through all pathways and agreed that the score could change 2.5 to a 3.5. Note that the level of treatment is the same for land as for the river. The land discharge will provide some additional removal of nitrogen. From a cultural perspective, the land is only a minor component and the overall impact of the option on the river is more concerning. With respect to social impacts, the scores do not reflect the size of the footprints – hard to assess as depends on land uses – if discharging to a forest potentially no impact but if discharging to productive land could be a big impact. Subsequently there may be consideration needed of these scores changing. Amend the resilience scoring from a 3 to a 3.5 on the basis there is greater ability to provide for discharging to land as an alternative to the river as the city grows. Agreement by the group to amend the Public health scores for the plus land option as these were considered harsh in comparison to some other options when you take the enhanced treatment into account and the treatment provided by land. Based on the number of critical pathways – comfortable to change from a score of 2.5 to a 3.5
2. Dual R+L	Two river discharge points and a small portion to land	When comparing the public health score for Options 1 and 2, why have both options scored 4 when Option 2 has a lesser level of treatment. In comparison with option 1, there are an increased number of receptors and therefor risk. Agreed scoring change from a 4 to a 3.5 on this basis.

		Environmental scoring is based on how well the One Plan targets are met. The discharge at Opiki avoids river gravels, periphyton risk is lower, other issues to be considered although treatment levels are not as high. Scored better that Option 1 but very little difference. It was noted that the Totara Road location is very good at growing periphyton, hence very low nitrogen limit. This compares less favourable (only slightly) that this option given the environment at Opiki. Confidence in the social score (because it does not consider number of communities affected) is a concern. Infrastructure scored a 3 for this option because there is a high element of potential resource recovery, scores lower for upscaling for a sub-regional scheme can address this from a treatment perspective but not from an infrastructure perspective.
3. L+R(a) & (b)	97% Applied to land (inland location) and discharge to the River in exceptional circumstances	The inland site is driven by effects on ground water, the ocean effects are on ocean streams and lakes. Targets are used in determining the toal land area required ie 21-25kg/ha/year leaching targets. This will ensure the Irate of discharge is at a level that will be acceptable for receiving environment. Inland soils are less ideal and will not require irrigation in winter. On this basis, if 97% driving negative outcomes what about 80-70% - is this a linear thing? Experts noted that once get into wet months, 'we really want to get off those soils' Hydraulic loading plays a major contributing role in the rate and timing of discharges. Consideration may be given on 70/80% loading. There are financial implications of ocean areas versus inland areas and further financial modelling should be completed to fully understand the impact of these options on options costs and the region economy. With growth and the region's economy, understanding what the potential loss of jobs with farming land use change are needed. PNCC's reputation could be challenged by farming community – should the scores be higher for ocean areas but lower for the inland areas? This option would this be the largest land application scheme in New Zealand. Currently, Taupo is currently the largest scheme at 500ha Scoring has also considered the ability to adapt to a sub-regional scheme in time.
	97% Applied to land (ocean location) and discharge to the River in exceptional circumstances	
4. L + R (d) & (e)	45% of the time discharge to land (inland) and remainder of the time to the River	The ocean sands options did not score well from an environment perspective because of effects on ocean lakes and streams, soils less effective removing nutrients.

	55% of the time discharge to land (inland) and remainder of the time to the River	In terms of public health - inland areas only 5 critical pathways, ocean areas have 8 critical pathways because of shellfish and ocean lakes and streams. The differences in land costs seems too low. What are the differences in income between cut and carry and forestry? Aslan Perwick - $2,000/ha/year for inland soils (cut and carry) and $1,200ha/year for forestry. Agreed that this requires further explanation and potentially more up to date analysis.
	45% of the time discharge to land (ocean) and remainder of the time to the River	
	55% of the time discharge to land (ocean) and remainder of the time to the River	
5. Ocean	Ocean discharge with small portion to land (ocean)	There are limited environmental benefits to including land as part of this option. There can be commercial benefits if it involves the right land use, but costs associated with land purchase. This is a good option from an environmental perspective, potential land effects good as only a small area of land required and in summer taking out nutrients. Because of the small area of land required able to avoid sensitive lakes. From a public health perspective, the option without the land component scored a 5 because it had the least critical pathways. The land component could be a dilemma depending on where it is located. It was then agreed to increase this criterion from a 2.5 to 3 based on further comparison with other option scores. Noted that Option 1 has a higher quality treatment than Option 6. Option 6 does however provide some improvements. If the discharge is half the flow half the year, a smaller land area is required and can avoid streams and lake catchments. It is very difficult to get to these streams and lakes and further investigation is needed to explore how many people are potentially affected ie activities such as gathering watercress. On this basis it was further supported to increase the public health score from a 2.5 to a 3. An ocean discharge is low risk on aquatic life primarily because of the length of the outfall – 2km offshore, involves some nitrogen removal as diverting half the flow to land in the summer. However further information is needed by Iwi before this can be considered further. Growth and economics have scored highly primarily because it is the most acceptable for a sub-regional scheme (based on information presented so far). Noted that for sub regional schemes the treatment does not have to all be at Totora Road, could be Feilding etc. This detail is yet to be explored and could be considered as part of some further options refinement.
	Ocean Discharge 100% of time.	

4.3 Weighting

The need to give relative weighting to each criterion was agreed by decision makers at the end of Day 1 of the MCA workshop. This was largely driven by the consensus that scoring alone did not provided Council with clear direction on a single preferred option. Day 2 was then focused on exploring weightings, reflecting decision maker views, and allowing for debate and discussion during the workshop. Experts were deliberately removed from the decision makers during the weighting scenarios portion of the workshop to ensure there was no technical expertise influencing the process. They were asked to develop their own two alternative weighting scenarios in a separate room based on their professional and technical expertise, one being without financial weighting and one with an agreed financial weight of 15%. These weightings are presented below (refer Table 7).

A total of ten different weighting scenarios were developed by both Councillors and Stakeholders (decision makers), and the technical experts as a separate group. Within the agreed weightings identified, the following themes and considerations were discussed by the group:

- There are two scenarios being considered, including with a weighting on finance and without. It was agreed to put 15% of the weighting to finance, which has had little to no impact on the overall results because of the close range of all weightings calculated across the criterion. For example, a weighting of 40% to a criterion was necessary to alter the outcomes of the top ranked 3 options.
- A consistently low weighting was given to the Technology and Infrastructure criterion. This was because the preferred option is expected to deliver on the technology and of the options presented, all provided improvements to the current treatment levels.
- Maori Cultural Values was the highest weighted criteria (consistently), which was an agreement by a majority of attendees.
- Growth and Economic Development, along with Public Health were considered of almost equal weighting importance. This is because the solution being adopted must ensure people's health are not impacted and a long terms solution for the city's growth, with the potential for the region's growth to be considered was important to the council.
- A level of confidence was low in relation to the social and community criterion. This was because the assessment to date was limited to a desk top exercise and it was recommended by experts that site specific investigations would be suitable to determine the full scale of impacts associated with each option.

Table 7 MCA Base Weightings considered at workshop

Weighting Scenarios	Public health	Natural environment	Māori cultural values	Social & community	Financial implications	Technology & infrastructure	Resilience	Growth & economic development
Base workshop weighting scenario	**15.0%**	**15.0%**	**20.0%**	**15.0%**	**15.0%**	**0.0%**	**5.0%**	**15.0%**
Alternative workshop weighting scenario (if required)	**10.0%**	**10.0%**	**15.0%**	**40.0%**	**10.0%**	**0.0%**	**5.0%**	**10.0%**
Councilor Agreed -Without Finance	**18.0%**	**20.0%**	**22.0%**	**12.0%**	**0.0%**	**0.0%**	**13.0%**	**15.0%**
Technical Group-Without Finance	**20.0%**	**20.0%**	**20.0%**	**20.0%**	**0.0%**	**5.0%**	**5.0%**	**10.0%**
Agreed Combined without finance	**20.0%**	**20.0%**	**20.0%**	**15.0%**	**0.0%**	**0.0%**	**10.0%**	**15.0%**
Agreed Combined With Finance	**15.0%**	**15.0%**	**20.0%**	**15.0%**	**15.0%**	**0.0%**	**5.0%**	**15.0%**
Social and Community- With Finance	**10.0%**	**10.0%**	**15.0%**	**40.0%**	**10.0%**	**0.0%**	**5.0%**	**10.0%**
Agreed Combined with Finance-Option 2	**10.0%**	**10.0%**	**15.0%**	**10.0%**	**50.0%**	**0.0%**	**0.0%**	**5.0%**
Councillor Agreed- With Finance	**15.0%**	**15.0%**	**20.0%**	**10.0%**	**15.0%**	**0.0%**	**10.0%**	**15.0%**
Technical Group- With Finance	**17.5%**	**17.5%**	**17.5%**	**17.5%**	**15.0%**	**3.8%**	**3.8%**	**7.5%**
No weight to financial implications	17.6%	17.6%	23.5%	17.6%	0.0%	0.0%	5.9%	17.6%
50% weight to financial implications	8.8%	8.8%	11.8%	8.8%	50.0%	0.0%	2.9%	8.8%
Equal weight to all criterion	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%
Part 2 RMA	20.0%	20.0%	20.0%	10.0%	5.0%	5.0%	15.0%	5.0%
confidence	50	70	60	20		80	50	30

4.4 RMA Part 2 Assessment

In addition to the weighting outlined in the workshop, a further assessment against the RMA Part 2 'Purpose and Principles' has been undertaken (Table 7 below). This table summarises how each of the relevant sections of the RMA are being applied across the criteria developed for the MCA and the relevant weighting that should be applied. The outcome of this weighting is included in Table 9 below for comparison against options weightings from the workshop.

Table 8 Assessment of RMA Part 2 'Purpose & Principles

Criteria	Relevance of criterion to Pt 2	Weight
Public health	Where is it covered in Pt 2? s5 – enabling people & communities to provide for health & avoid, remedy & mitigate adverse effects Assessment Critical RMA Pt 2 issue to address in a wastewater project, but specific relevance is confined to s5.	20
Natural environment	Where is it covered in Pt 2? s5 - safeguard life supporting capacity, avoid remedy or mitigate adverse effects; s6 - preserve natural character & significant habitats; s7 intrinsic values or ecosystems, and the maintenance & enhancement of quality of the environment Assessment Critical Part 2 issue to address in a wastewater project, and the criterion has specific relevance to most sections of Pt 2 (except s8).	20
Māori cultural values	Where is it covered in Pt 2? s5 - enabling people & communities to provide for cultural wellbeing; s6 - relationship of Māori and culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga; s7 - kaitiakitanga; s8 - principles of the Treaty of Waitangi Assessment Critical Part 2 issue to address in a wastewater project, and the criterion has specific relevance to all sections of Pt 2.	20
Social & community	Where is it covered in Pt 2? s5 - enabling people & communities to provide for social wellbeing, & avoid, remedy and mitigate adverse effects; s7 - the maintenance and enhancement of amenity values Assessment Important, but less critical Part 2 issue to address in a wastewater project. Specific reference is only made to the criterion in s5 and it	10

	has relevance to the s7 amenity reference. TBC - Social considerations associated with recreation, are in part captured under the Public Health criterion.	
Financial implications	Where is it covered in Pt 2? s5 - enabling people & communities to provide for… Assessment Of only general relevance under Pt 2 of the RMA	5
Technology & infrastructure	Where is it covered in Pt 2? s5 - enabling people & communities to provide for… Assessment Of only general relevance under Part 2 of the RMA	5
Resilience	Where is it covered in Pt 2? s5 - enabling people & communities to provide for…; s6 - the management of significant risks from natural hazards; s7 - the effects of climate change Assessment The criterion has specific relevance to most sections of Pt 2. However, while ensuring a resilient wastewater system is important, to a certain degree this is a design consideration and not as critical as some other factors.	15
Growth & economic development	Where is it covered in Pt 2? s5 - enabling people & communities to provide for… Assessment Of only general relevance under Part 2 of the RMA	5

4.5 Analysis

The scoring of the eleven different options, using the seven different weighting schemes is given in Table 9 below. The average score for each option and their relative rank compared to other options are also given for weighting scenario developed (refer Table 8 above).

It should be emphasised that scores represent an assessment of the likely scale of the impact. Scores can range from "0" for absolutely no impact, through to a maximum of "5" for extreme difficulty. In reaching decisions about which option is preferred it is therefore useful to compare scores between options and hence the rank of the scores is also given in Table 8.

Table 9 MCA Overall Weighted Scores

Options	Option Description	Base workshop weighting scenario	Rank	Alternative workshop weighting scenario	Rank	No weight to financial implications	Rank	50% weight to financial implications	Rank	Equal weight to all criterion	Rank	Part 2 RMA	Rank
1: R2(b)	River discharge with enhanced treatment	2.8	7	3.1	**2**	2.8	8	2.8	4	3.1	**2**	3.0	5
	River discharge with enhanced treatment, and a small % to land	2.6	9	2.9	5	2.7	9	2.4	7	3.0	6	2.9	8
2: Dual R + L	Two river discharge points and a small % to land	2.8	6	3.0	**3**	2.8	6	2.8	5	3.0	5	3.0	7
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	3.0	**3**	2.8	6	3.1	4	2.7	6	2.9	8	3.2	4
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	2.9	4	2.8	7	3.3	2	2.2	11	3.0	6	3.3	**2**
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	2.9	5	2.8	8	2.9	5	2.9	**2**	3.0	4	3.0	6
	55 % applied to an inland land application site and a river	3.1	**2**	2.9	4	3.1	**3**	3.0	**1**	3.1	**2**	3.2	**3**

Options	Option Description	Base workshop weighting scenario	Rank	Alternative workshop weighting scenario	Rank	No weight to financial implications	Rank	50% weight to financial implications	Rank	Equal weight to all criterion	Rank	Part 2 RMA	Rank
	discharge for the remainder of the time												
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	2.3	10	2.2	10	2.2	10	2.4	8	2.4	10	2.4	10
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	2.2	11	2.1	11	2.2	10	2.2	10	2.3	11	2.3	11
6: Ocean	Ocean discharge, with a small % to land	2.7	8	2.4	9	2.8	7	2.3	9	2.7	9	2.8	9
	Ocean discharge	3.2	**1**	3.3	**1**	3.4	**1**	2.9	**3**	3.2	**1**	3.3	**1**

4.6 Sensitivity Review

In general, the differences in scores between the options are relatively small. This suggests that results will be more sensitive to changes in the individual scores. Typically, a change in one score point will result in slightly less than a 0.1 change in an option score. Therefore, it will take a “2” or “3” point score to significantly change the relative ranking of options for a particular weighting scheme. I it is therefore likely to take substantially more score point changes within a single option, to give a different preferred option.

5 Discussion

The following section summarises key discussion points for each of the five options following the completion of scoring and discussion at the MCA workshop on the 9th and 10th of November.

Table 10 Summary Conclusions and Discussion of options at completion of the MCA Workshop

Options	Option Description	Discussion
1: R2(b)	River discharge with enhanced treatment	Similarly, with the Ocean Discharge option (Option 6), Option 1 is one of the top 3 ranked options. Largely because of the high treatment standard/method adopted for this option, compared to all other options, the criteria for public health, social and community, technology and infrastructure, resilience have all scored 4 out of 5. This is because it ensures the public health and environment are protected with less risk than other options that public health and the environment will not be compromised. One Plan standards are met most of the time with this option (still not met 10 days/year). Further investigations are needed to confirm how Council may be able to discharge some treated wastewater to land to ensure compliance is met 365 days a year ie no non-compliance under One Plan. This may require more land and/or frequency of the discharge to land increased. From a Maori cultural values perspective, this option is scored the lowest as it is considered completely unacceptable to discharge wastewater to the River.
	River discharge with enhanced treatment, and a small % to land	Comparatively, this option has not been ranked in the top 3 or the bottom 3 of the 11 ranked options. A constraining factor to this option is the portion of land explored with this option increases costs and therefore, the option is scored relatively low for costs. From a Maori cultural values perspective, this option continues to discharge most of the treated wastewater to the River and therefore is scored low (consistent with Option 1 '100% to river' and Option 6.
2: Dual R + L	Two river discharge points and a small % to land	Option 2 has ranked in the middle consistently. The scoring provided for Public Health and Natural Environment is 4. This is because there is a higher treatment method adopted for this option in conjunction with discharges occurring where there is less sensitivity to public health and the environment is less sensitive. From a social and community perspective, the option is ranked 3.5 as consistent with Option 1 'river and small % to land'. The option essentially discharges into 3 locations, presenting effects on multiple individuals and communities. As with Option 1 and Option 6, this option is not considered a viable solution from a Maori Cultural Values perspective as it is not acceptable to discharge wastewater to the River.
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river	This option was not considered a top rankikng option compared to Options 1, 4 and 6. However was identified as a preferred option through the public consultation process held in early 2020 and noted at the workshop by key stakeholders.

Options	Option Description	Discussion
	in exceptional circumstances	The discharge to land a majority of the time (97%) is the most favourable from a Maori Cultural Values perspective, scoring 4 and 3.5 respectively (inland and coastal soils). The preference from Iwi for the inland option (compared to coastal sands), is based on the strong desire for mitigating effects on neighbouring Iwi. This would be achieved through identifying land that is within the Rohi of Rangitane and within the Councils land jurisdiction as much as possible (if feasible). However social and community criteria, and growth and economic development criteria were both scored low (2.5 and 2). This low scoring is based on the likely severe impact on individuals and community groups caused by the significant land area (3,5000ha of land) necessary to implement this solution. The area is likely to sever communities and cease activities that have occurred in areas for some time. The well being of people may also be impacted where the way they used to control their day-to-day activities will no longer happen ie no longer farming. This scoring however was given low confidence on the basis the site is not yet confirmed, and further investigation is needed by experts. It was still very much recognised as a major concern by decision makers and key stakeholders. This option was scored mid-range across the remaining criteria. Therefore, the option was not consistently scored as a top 3 option and was also not falling in the lowest 3 options.
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	Similarly, with the 97% to inland land, the coastal sands option was favourable to Iwi in comparison to river and ocean options being assessed. However, the coastal sands option is the least affordable and scored the lowest for a financial implications' perspective. This option also has a mid-range score from a social and community impact due to the size of the land required and proximity to the coastline. The same reasoning identified for the inland option is considered in this option for social and community impact. This option does score slightly better for Public Health and Environmental standards on the basis the receiving environments are less sensitive and there are less receptors potentially impacted (both scoring 4).
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time 55 % applied to an inland land application site and a river discharge for the remainder of the time	The 45-55% inland fluvial soils option has been identified as top-ranking options, more favourably the 55% discharge to inland fluvial soils, across each of the weighting scenarios. From a Maori cultural values position, the option provides some improvement to the River by accommodating a majority (or large proportion) of the wastewater to land (which is preferred). Therefore, the score of 3 has been applied from Iwi. A score of 4 was provided for the Natural environment and scores of 3 or above (up to 3.5) for the Public health, technology, resilience and a growth and economic development assessment. The large land area and infrastructure requirements for this option contribute to the lower scoring for financial costs. In addition to this, the social and community implications are consistent with Option 3, in there are communities

Options	Option Description	Discussion
		and individuals with land holdings that are likely to be adversely impacted by this option. It was then agreed that further investigation was needed to identify the full extent of adverse impacts on individuals and the community as well as up to date land costs.
	45 % applied to a coastal land application site and a river discharge for the remainder of the time 55 % applied to a coastal land application site and a river discharge for the remainder of the time	Option 4 '45% - 55% coastal land application' have consistently ranked 10 and 11 (out of 11) across the range of criteria weightings explored at the MCA workshop. Scoring that has heavily influenced this outcome is Public Health, Maori Cultural values, social and community, growth and economic development, financial implications were all scored less than 3 for the scoring provided by experts. In addition, this option requires significant investment in infrastructure, increases overall costs for this option. There is also increased risk of infrastructure failure when considering resilience (natural hazard/climate change) and therefore did not score highly under these criteria. The workshop attendees agreed with low confidence scoring to financial, social and community criteria. the social and community implications are consistent with Option 3, in there are communities and individuals with land holdings that are likely to be adversely impacted by this option. It was then agreed that further investigation was needed to identify the full extent of adverse impacts on individuals and the community as well as up to date land costs.
6: Ocean	Ocean discharge, with a small % to land	As is identified with Option 4 "45% - 55% coastal land application", this option presented low confidence for decision makers as it is consistently in the lowest 3 ranked options. As outlined in Option 4 'coastal sands' options, this option scored lower across the financial, social and community, public health, growth and economic development and Maori cultural values assessments. It was agreed by decision makers that this option was not considered a viable option to take forward given the range of impacts, risks and high costs identified .
	Ocean discharge	The 100% Ocean discharge option is recognised as consistently in the top 3 ranked options when reviewed across each of the weighting scenarios. The criteria that scored the highest included public health, natural environment, growth and economic development and resilience. This was largely on the basis technical experts identified there are less receptors and a less sensitive receiving environment that treated wastewater can be discharged to when discharging into coastal waters. It is however recognised that there are further effects assessments needed before the confidence given to this option is acceptable. This option is also considered the most favourable to adopt a regional or sub-regional scheme, whereby Councils growth and neighbouring councils' wastewater, can be incorporated into a sub-regional scheme over time. Alternatively, the remaining options may be less viable solutions given the constraints of the receiving environment (to accommodate increased flows and loads within the consent duration and/or beyond 50 years).

Options	Option Description	Discussion
		This option is considered to the one of the least favourable from an Iwi perspective (in addition to River options). A point made by Iwi at the workshop concluded that significantly more work is needed before a position from Iwi can be revised. It was also noted that consideration of Iwi not represented at the workshop will be very important and the scoring does not represent the value wider Iwi have on the coast. Awareness was raised by Rangitane that Iwi (including those not represented at the workshop) will not be supportive of this option.

5.1 Additional Investigations

Following the MCA workshop held on the 9th and 10th of November, the following technical work was agreed to be undertaken by Councils' Project Team and presented back to the Project Steering Group for the Project:

- Updating options with Councils latest growth projections and incorporation of updated growth projections from neighbouring Councils and major industry (MCA/HDC). This work is to further identify the growth rates (low/medium/high) to assist decision makers in understanding the option that provides the optimal solution for Councils planned growth rates as well as contingency within the consent duration being applied for.
- Update the land values that have been incorporated into financial information used. This is to give confidence to par5ticipants that the cost of options is as accurate as possible through the evaluation process.
- Further assessment of potential effects from a coastal outfall (in the proposed coastline) is needed and this is then to be shared with decision makers, Rangitane Iwi and key stakeholders.
- Explore whether there is a 'staged implementation' available for options including a discharge (or partial discharge) to the River. This was discussed towards the close of Day 2 of the workshop and is considered a potential solution that achieves higher standards of wastewater treatment over time, staged implantation of land-based discharge over time and potentially reducing costs to Council.
- Investigate if options requiring a discharge to the River and ocean can be optimised. This may include higher treatment standards being adopted or the refinement between land and River discharge being made. This work will involve further modelling of River contaminants and information researched on local ocean environments that are.
- Assessment of alternative land use and revenue streams particularly for land-based options to improve the robustness of option costs.

6 Conclusion

6.1 Overview

Significant technical work has been undertaken by the Council to refine the shortlist options since they were identified in June 2019. The 5 shortlisted options (with variants) have been assessed through a Multi-Criteria Assessment, assisting the Council to determine one or more preferred options. The MCA has been adopted by the Council as one tool within a range of tools, assisting Council decide on the BPO (Figure 3).

This MCA process was attended by most Councils elected members, Rangitane and Muaupoko Iwi representatives, and key stakeholders. Briefing material and workshops were held prior to the two-day MCA scoring and weighting workshop to ensure attendees were well informed leading into the evaluation process (refer Section 3). Following the two-day workshop held in November 2020, the Council was unable to identify a single preferred option however were able to recognise the top-ranking options for further consideration.

Significant steps were however made by completing the MCA process, as this has guided the Council towards a BPO through identifying additional work that will assist in options refinement and increasing the robustness of the information used in the assessment process.

6.2 Key Outcomes of the MCA

In summary, the MCA process confirmed the following for Council:

- No single option has been identified out of the MCA assessment process as a preferred BPO. Sensitivity testing involving changes to the weightings of the criteria confirmed that scoring changes of less than 0.3 did not change the top-ranking options.
- Even when assessed against a range of weighting scenarios, the top 3 options are consistent. Options with the lowest ranking scores were also consistent across the weighted scenarios. The favourable options
    - Option 1 - Most of the treated wastewater being discharged to the Manawatu River with substantially high treatment and a portion to land. This will closely meet One Plan targets. While this option was not well supported by Iwi, considerations of a higher standard of treatment were proposed by several key stakeholders and decision makers.
    - Option 4 - A 45% discharge to inland fluvial soils. However, this option should seek to reduce the land area requirements and providing a high standard of treatment 55% of the time for the River discharge component.
    - Option 6 - Ocean discharge. This option scored well due to its ability to provide a regional or sub-regional scheme. Feedback from the workshop suggested that a higher level of treatment may need to be considered than currently proposed to allay concerns of Iwi and other stakeholder feedback.
- Additional technical work should be undertaken prior to deciding on the BPO and to inform the wider assessment process. This technical work is outlined in Section 5.1 above. The information will assist Council with refining shortlist options and provide stakeholders and decision makers with greater confidence in respect to effects on the river and ocean, social and community and costs of the options, as well as mitigation of potential adverse effects.

In summary, the MCA has provided with further direction in the options assessment process. The receiving environments that have been identified as potential options include a combined option of river and land (inland fluvial soils) options or an ocean discharge. The treatment levels proposed for these options are driven by meeting One Plan Standards and when assessed against the range of criteria used in the MCA process to score each option, it is the options with the higher standard of treatment that is preferred and options including the least amount of land necessary that is inland (fluvial soils).

6.3 Next Steps

Out of this MCA, the Council confirmed that the MCA with Iwi and a further round of engagement and consultation with stakeholders and the community will be valuable in guiding Council's selection of the BPO. In addition to this, the assessments identified in Figure 3 will also be important for the completion of the alternative's assessment process under the RMA and Councils overall recommendation for the BPO (by June 2021).

As such, the following conclusions drawn from the MCA process are considered relevant in the upcoming engagement processes include:

Preferred Options 1, 4 and 6 and reasoning:

- Although there was no clear preferred option, it is recommended that Council highlight the smaller number of options which rank more highly and seek specific feedback on clear trade-offs, these being:
    - Option 1 '97% to River'
    - Option 4 '55% to fluvial soils and remainder to River'
    - Option 6 'Ocean'
- The natural environment is highly valued by the Council and options considered in the top 3, propose the highest levels of treatment being considered by Council across all the options.
- There was strong support for exploring options that reduced land areas and provided higher treatment as a mitigation strategy to negative impacts on productive land capacity, hence Option 4 being preferred.
- Providing a higher level of treatment would represent a departure from the premise underpinning option development to date which was that treatment should be sufficient to mitigate effects for the receiving environment given this will be necessary to gain a consent under One Plan.

Options not considered preferable and the reasoning behind this includes:

- Options requiring significant land areas (2,500ha to 3,500ha) i.e Option 3 '97% to land', would be considered problematic and likely not feasible due to the significant quantity of. Class 1 soils required. The consumption of significant areas of Class 1 agricultural soils and areas suitable for urban development was considered a significant disbenefit.
- Concern that the true costs of large areas of land purchase in the region, along with the complexity of purchasing such large areas, will be a challenge for the Council to overcome. Therefore the 97% to land options are considered less desirable to proceed with.
- Although provisional, the scoring for land-based options (particularly 97% to land and coastal sands areas), these effects are still a risk to Council in proceeding with an

option with confidence the effects can be mitigated or minimal on the environment. While these effects on individuals and the community of large-scale land irrigation systems, will be refined at the AEE stage, a pre-cautionary approach is preferred when considering land-based options.

- Concern that the extent of social impacts for each option, particularly land-based options, is not fully understood at this stage of the process. Options 2, 3 and 4, which requires more than 1,000ha and up to 3,500ha of land, may have substantial effects and therefore confidence is generally low for Council.

The outcome of the MCA process to date has highlighted that Council while Council is not yet able to confirm a preferred option, there were several options which scored consistently well across a range of criteria and weightings.

Appendix 1: MCA Briefing Material

PALMERSTON NORTH

NATURE CALLS

Wastewater BPO

Understanding the Assessment Criteria

5th November

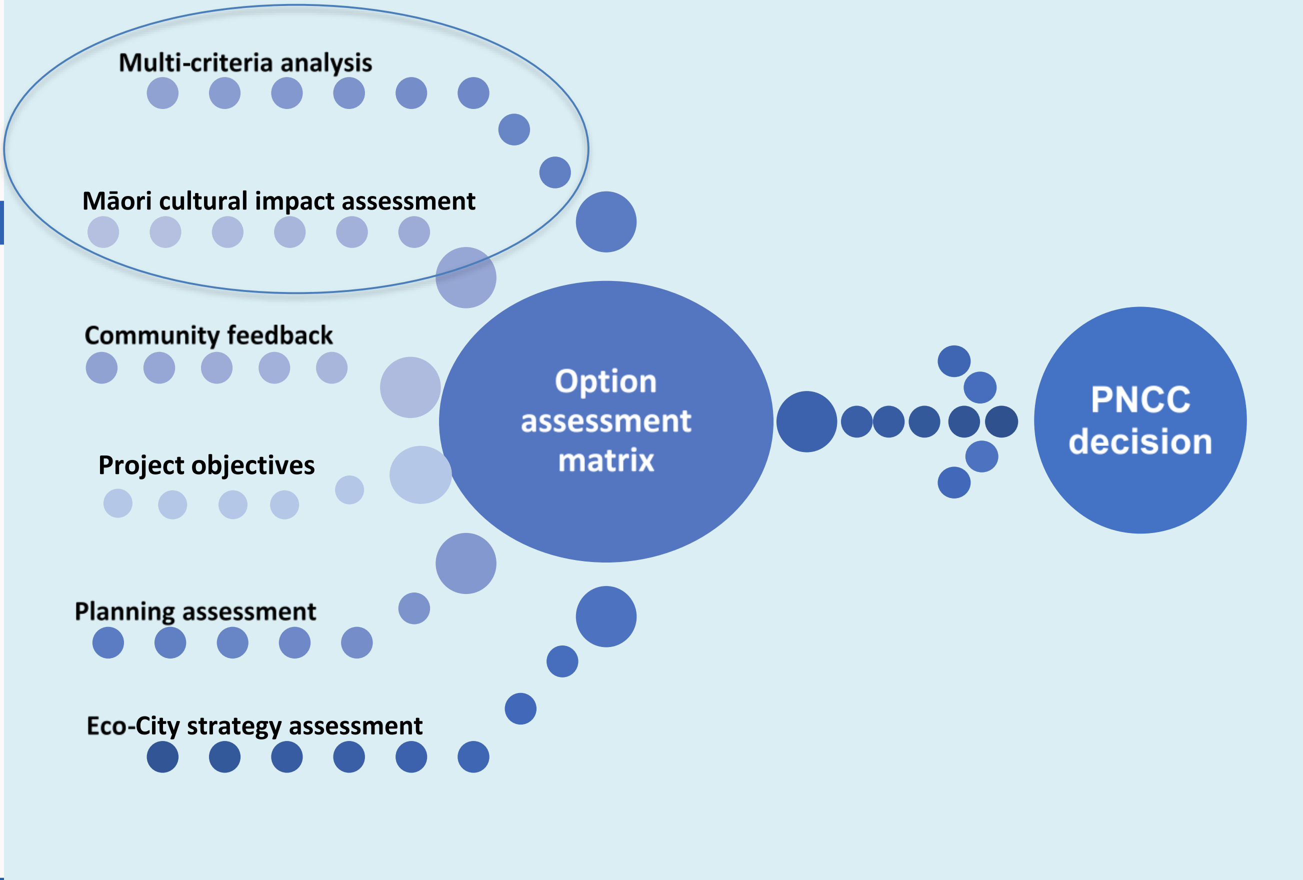
HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Welcome Councillors & Stakeholder Representatives

What to expect today:

- Understand the Assessment Criteria in preparation for 9th - 10th Nov
- Workshop on 9th - 10th Nov
  - General flow of the day
  - Who is attending
- Questions and Answers

Overall Approach



Multi-Criteria Analysis (MCA)

- Systematic way of comparing options using a range of criteria
- For complex problems it provides a **relatively** simple way of comparing their merits
- MCA does have limitations that need to be kept in mind - inherent 'subjectivity' and unconscious bias of the participants – sensitivity testing
- Use a collaborative workshop process, involving partners and stakeholders

1. Select the assessment criteria
2. Determine the score for each option against each criteria
3. Agree the importance of the criteria (weighting)
4. Calculate the overall result

Public Health

What does this mean?

Degree of public exposure to health risks in treated wastewater (including through land application):

- qualitative assessment of public health risk based on critical exposure pathway
- potential degree of difficulty in controlling public health risk

Example of what it is...

- Pathogens (germs, viruses & bacteria)
- Water supply protection (nitrogen)
- Pathways through which people can be exposed
  - Recreation
  - Food gathering & consumptions
  - Drinking water
  - Spray drift

Example what it's not ...

- Work safety
- Emerging contaminants
- Risks from beneficial re-use
- Risks from treatment plant failures or malfunction

Natural Environment

What does this mean?

Potential adverse environmental effects on the receiving environment (including the Manawatū River), particularly in relation to water quality (including the matters listed in s107 (1) (c) to (g)), soils, aquatic ecology and terrestrial ecology

Example it is...

Potential effects on nutrient loads, algae growth, macroinvertebrates and fish in the Manawatu River, small streams near irrigation areas and the coastal environment.

Potential effect on soil health and structure.

Example it's not ...

Effects on recreational bathing water quality, drinking water, cultural values, or economic costs.

Māori
Cultural Values

What does this mean?

Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Māori, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga

Example of what it is...

- Assessment by Rangitāne o Manawatū
- Assesses options against key parameters of concern for Rangitāne:
  - Values: their mana, their taonga, mauri and wairua in their rohe
  - Landscapes
  - Atua domains
  - Acceptable to Rangitāne people

Example of what it's not ...

- While the assessment had input from some neighbouring iwi, the report does not speak on their behalf
- Other iwi speak for themselves and may choose to provide separate feedback on options

Resilience

What does this mean?

Degree to which the option is resilient to natural hazards and climate change

Example it is...

- Natural hazard risks from:
    - earthquakes
    - land movement & erosion
    - flooding
    - storm surge/tsunami
- Climate Change / Adaption
    - High intensity rainfall
    - Prolonged wet weather
    - Prolonged dry periods
    - Increased period of low flows
    - Sea and groundwater level rise

Example it's not ...

- Operation resilience
- Wild fire risk
- Climate change risk to crops on land application areas

Financial Implications

What does this mean?

Comparative capital, operational, whole of life costs of the options.

Example it is...

Objective assessment of the cost of the options, including:

- Treatment plant upgrades
- Conveyance pipes & pump stations
- Purchase of land application areas and irrigation infrastructure
- Wetland & land passage costs
- Operational & maintenance costs
- Land use & ETS income

Example it's not ...

- Its not a subjective assessment of 'affordability'
- Its not an assessment of the financing opportunities for the different options
- Its not an assessment of the benefits and costs to the city or regional economy

Technology & Infrastructure

What does this mean?

Degree to which the option:

- can be staged
- is able to be constructed and operational within 5 years of the commencement of the consent
- allows for resource recovery / beneficial re-use
- infrastructure can be up-scaled, prior to and post initial construction, to accommodate a sub-regional scheme
- involves Operational Complexity
- involves Operational Risk

Example it is...

- Takes account of the need to acquire land in some options
- Otherwise focusses mainly on the complexity and flexibility of the infrastructural elements of each option

Example it's not ...

- Receiving environment limits on sub-regional schemes not considered under this criterion

Growth & Economic Development

What does this mean?

Will the option support the population and economic growth anticipated for the City by Council?

Example it is...

The ability for an option to meet future growth demands and a sub-regional option

The effect an option has on the ability for the city and region to growth

The effect an option has on the Regions economy

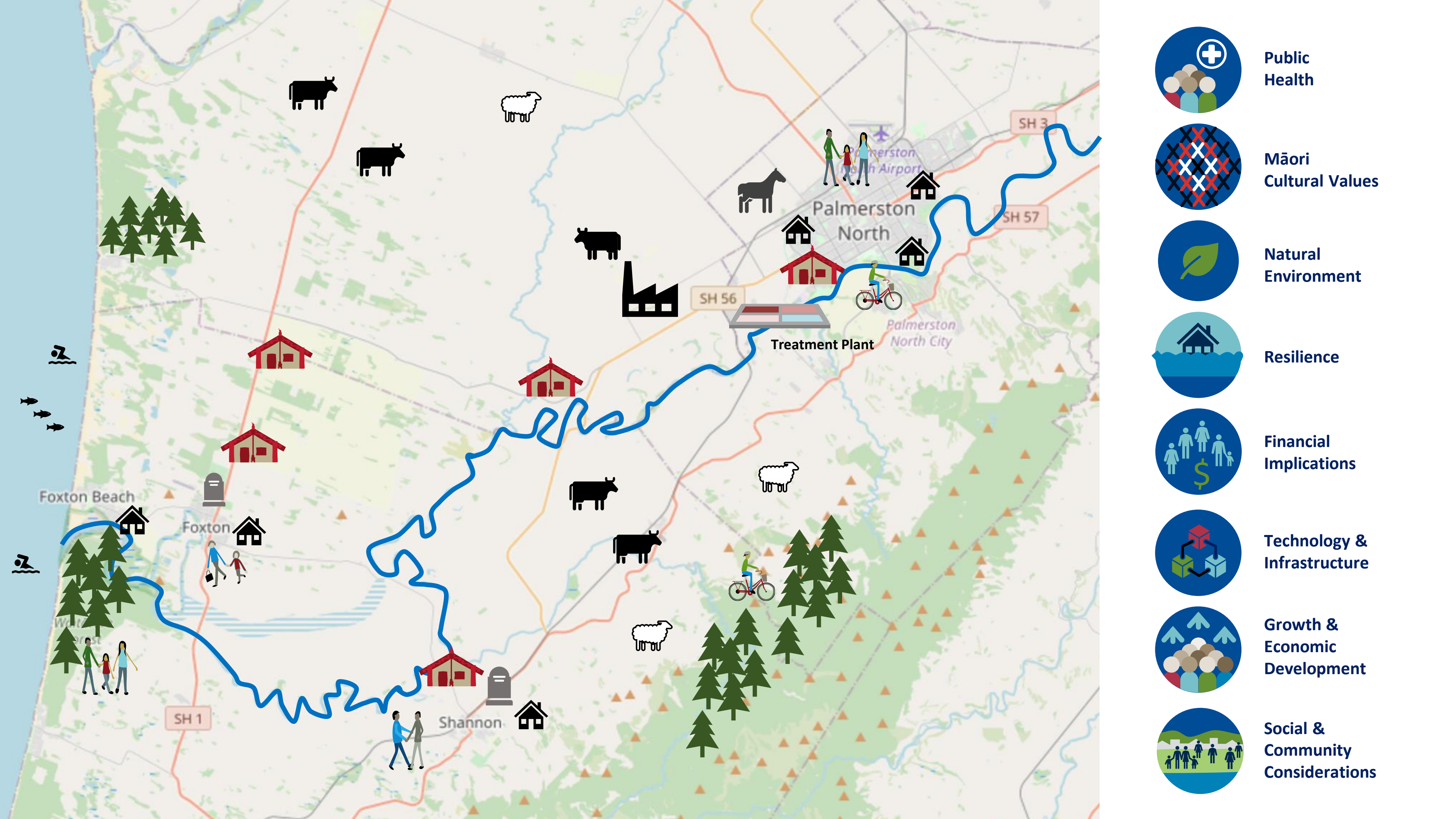
Example it's not ...

The effect of the option on economic losses due to public health effects.

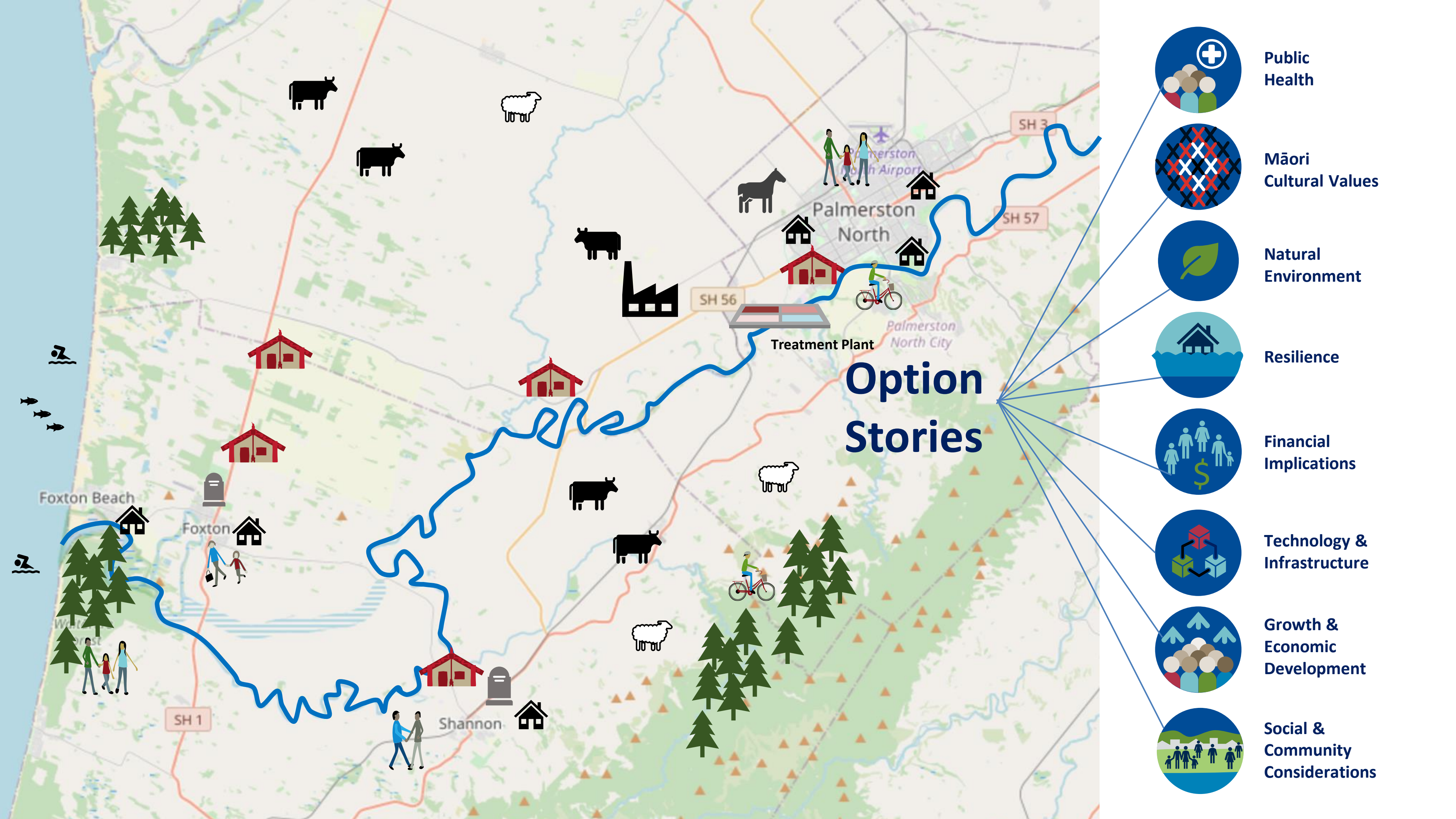
The effect on property values

Social & Community Considerations

What does this mean?	Example it is...	Example it's not ...
Potential adverse effects on social and community values relating to amenity, recreation and food gathering	Effect of an option on people's quality of life and access to basic necessities of life ie education and livelihoods The effects on ecosystems that contribute to peoples well being Community support or dislike	The effect of a solution on individuals' property values Changes in occupation or land use



SH 3
Palmerston North Airport
Palmerston North
SH 57
SH 56
Treatment Plant
Palmerston North City
Foxton Beach
Foxton
SH 1
Shannon
Public Health
Māori Cultural Values
Natural Environment
Resilience
Financial Implications
Technology & Infrastructure
Growth & Economic Development
Social & Community Considerations


Option Stories
Public Health
Māori Cultural Values
Natural Environment
Resilience
Financial Implications
Technology & Infrastructure
Growth & Economic Development
Social & Community Considerations
Treatment Plant
Palmerston North
Palmerston North City
SH 3
SH 57
SH 56
SH 1
Foxton Beach
Foxton
Shannon

The MCA Workshop Nov 9/10 – What to expect

Qualitative conversation supported by a **quantitative** MCA assessment

Day 1 – Gain Insight and shared understanding

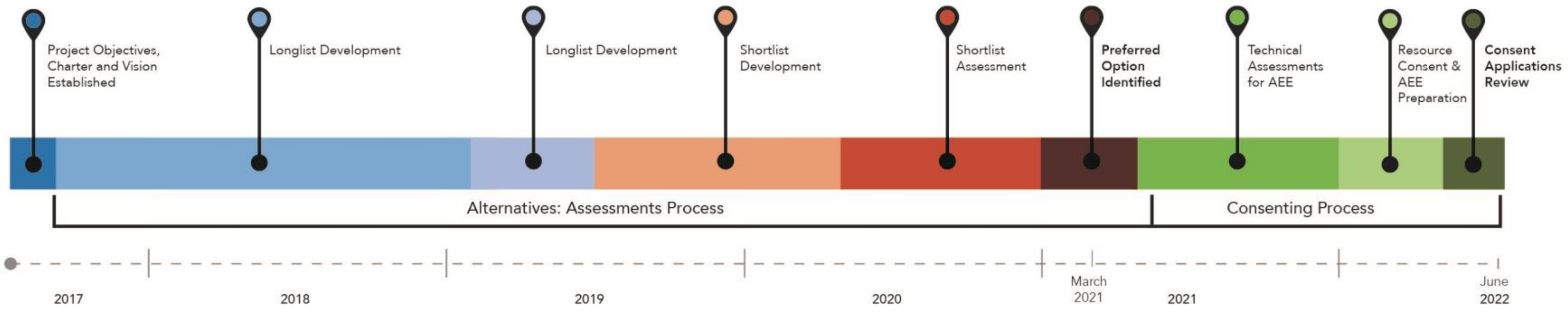
- Technical specialist- present how they went about scoring specific criteria & why (15 mins each criteria)
- Understanding the Options
  - Consolidated scores from specialist's
  - Discus to collectively understand/further group input
  - Build up an integrated story about each option - integrated specialist view
- Overall option score variation – scoring high/low
- Collectively agree weighting (if any, will apply overnight)
- Refresh MCA scores based on collective inputs/enhanced understanding (if any, will apply overnight)

Day 2 - Trade-offs between the options

- Weighting Sensitivity Testing
  - Weighted option scoring results
- Lock in the weighting(if any)
- Can we shortlist a preferred option(s)?
- Summary wrap up – option story
- Next steps - what further information do we need going forward

Timeline of Events

MILESTONES AND HIGH LEVEL PROJECT PROGRAMME NGĀ PAE TUTUKI ME TE HŌTAKA TIRO WHĀNUI



Appendix 2: MCA Comparative Assessments

Palmerston North City Council

Wastewater BPO Project - Summary Document of Comparative Assessments Criterion and Scoring

Introduction

This report sets out a summary of the comparative assessments and specialist scoring that have been prepared to inform the wastewater BPO Multi-Criteria Assessment workshop being held on the 9th and 10th of November 2020. Each Comparative Assessment Report sets out the assessment methodology used, assumptions applied and criterion scores as recommended by the specialists. Refer to each comparative assessment report for this detailed information. The Criteria includes the following:

- Public Health
- Natural Environment
- Māori Cultural Values
- Social and Community
- Resilience
- Growth and Economic Development
- Technology and Infrastructure
- Financial Implications

The following tables provide the consolidated output presented in each comparative assessment. Please refer to the comparative assessment for the detailed assessment information for each assessment.

Consolidated Criterion for Scoring

The methodology behind the scoring of each option against each criterion is outlined in the table below.

Criterion	Description	1	2	3	4	5
Public Health	Degree of health risk to the public as a result of exposure to treated wastewater (including through land application)	Extreme	High	Medium	Low	None
Natural environment	Potential adverse environmental effects on the receiving environment (including the Manawatū River), particularly in relation to water quality (including the matters listed in s107 (1) (c) to (g)), soils and aquatic ecology.	Very High adverse effects. Major loss or alteration of baseline conditions (in absence of current discharge)	High adverse effect. Major alteration of baseline conditions (in absence of current discharge)	Moderate adverse effects Alteration to existing baseline conditions. Generally, effects are moderate but acceptable in the context of magnitude, spatial scale, duration and frequency.	Low adverse effects. Minor shift from baseline conditions or ecological populations (in absence of current discharge).	Very Low adverse effects. Very slight change in baseline conditions.
Māori Cultural Values	Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Māori, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga	Destruction of Rangitāne culture, connections and kaitiakitanga. Critical effect on Rangitāne o Manawatū	Significant effect or impact on all aspects of Rangitāne Mana, Toanga, Atua and natural resources	Major impact on all aspects of Rangitāne significant sites and natural resources	Minimal impact on Rangitāne significant sites and natural resources	Minimal to no effect on Rangitāne o Manawatū
Social and Community Considerations	Significance of potential social effects based on the gravity, distributive equity, the need for land acquisition and degree of permanence of land use change, and public support for the option	Severe	Major	Moderate	Minor	Insignificant
Financial implications	Capital cost, operational and maintenance costs and whole-of-life cost (determined as the net present value (NPV) of the option)	Financial implication scores have been calculated using a formula explained in the report.				
Technology and infrastructure	Degree to which the option: • can be staged • is able to be constructed and operational within 5 years of the commencement of the consent • allows for resource recovery / beneficial re-use • infrastructure can be up-scaled, prior to and post initial construction, to accommodate a sub-regional scheme • involves Operational Complexity • involves Operational Risk	Low degree of alignment with sub-criteria and/or High Operational Complexity and Risk	Low – Medium degree of alignment with sub-criteria and/or Medium-High Operational Complexity and Risk	Medium degree of alignment with sub-criteria and/or Medium Operational Complexity and Risk	Medium – High degree of alignment with sub-criteria and/or Low-Medium Operational Complexity and Risk	High degree of alignment with sub-criteria and/or Low Operational Complexity and Risk
Resilience	Degree to which the option is resilient to • natural hazards • climate change	Low degree of resilience	Low – Medium degree of resilience	Medium degree of resilience	Medium – High degree of resilience	High degree of resilience
Growth & Economic Development	The degree to which the options will: • Support the population and economic growth anticipated for the City by Council? • Support / restrict further up-scaling to accommodate a sub-regional scheme?	Low degree of	Low – Medium degree	Medium degree	Medium – High degree	High degree

Consolidated Draft Scores

The following table shows the consolidation of the final draft scores provided by each of the technical experts.

Options	Option Description	Public health	Natural environment	Māori cultural values	Social & community	Financial implications	Technology & infrastructure	Resilience	Growth & economic development
1: R2(b)	River discharge with enhanced treatment	4	3	1	2	2.8	4	4	2
	River discharge with enhanced treatment, and a small % to land	2.5	3.5	1	1	2.1	4	3	2.5
2: Dual R + L	Two river discharge points and a small % to land	4	4	1	1	2.7	3	3.5	2.5
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	3	3.5	4	1	2.4	3	3	2
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	4	4	3	1	1.1	3	3	3
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	2	1	3.0	3	3.5	3
	55 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	3	1	2.8	3	3.5	3
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	1	2.5	3	2.5	2
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	1	2.2	3	2.5	2
6: Ocean	Ocean discharge, with a small % to land	2.5	4.5	1	1	1.9	2.5	3	4
	Ocean discharge	5	4	1	2	2.4	2.5	3.5	4

1 Financial Implications Comparative Assessment of Short-listed options

1.1 Introduction

This report sets out the Financial Implications comparative assessment of the short-listed options for the Palmerston North Wastewater Best Practicable Option (BPO) project ("Nature Calls"). This report is an assessment of the relative cost to construct and run the options, it does not consider wider economic effects, nor does it include a subjective consideration of affordability. This report focuses on the development of draft scores for the multi-criteria assessment (MCA) of shortlisted options.

The report was prepared by:

Overall assessment of options

- Michelle Chew – Stantec Civil Engineering Technologist
- Anna Bridgman – Stantec Group Manager/Senior Civil Engineer
- Jim Bradley – Stantec Technical Specialist

Assessment of treatment

- Andrew Slaney – Stantec Senior Process Engineer
- Michael Tan – Stantec Process Engineer

Assessment of land application

- Aslan Perwick - PDP Groundwater Services Leader

Please note the costs outlined in this Comparative Assessment report are indicative, comparative costs only, and should not be used for budgeting purposes.

1.2 Criterion and scoring approach

Financial criteria scores have been derived from the estimated costs (capital, operational and maintenance (O&M) and Net Present Value (NPV) costs) of each option. This was done using the following approach. It should be noted renewals are treated as operational and maintenance costs.

1. Assign weighting to each of the three sub-criteria (capital, O&M and Net Present Value (NPV) costs).
2. Identify the options with the highest cost estimate for each of the three sub-criteria and give these options a score of 1

3. Calculate the three sub-criteria scores for all options using this formula:
   Sub-criteria score for Option X = ((1 – (cost of option X / highest cost)) x 4) + 1
4. Calculate an overall score by multiplying the sub-criteria score for each option with the weighting of each sub-criteria and summing the total
5. From the overall score determine the MCA score

The formula creates a ratio for each sub-criteria between the option cost estimates and the highest cost. It then inverts this ratio by subtracting it from 1. This is done to ensure that an option with a high cost for any sub-criteria is awarded a low score. The formula then converts the ratio into a score between 1 and 5 by multiplying it by 4 and adding 1 (the score already awarded to the option with the highest cost). Finally, an overall score rounded to 1 decimal place is assigned to each option based on the weighting of each sub-criteria.

The three sub-criteria were used for the following reasons:

a) Capital – this allows a comparison of the up-front costs required to get a new scheme operational
b) Operational & Maintenance – this allows a comparison of the annual running costs of each option
c) NPV – this gives an indication of how the whole of life costs (over the 35-year consent sought period) compare to each other

For this draft assessment, the highest weighting has been assigned to the capital cost sub-criteria (37% of the total cost score), 30% for the operating cost sub-criteria and 33% for the NPV sub-criteria (10, 8 and 9 out of a total of 27 respectively). It has been assumed that the initial capital investment needed to implement the selected scheme will have a significant impact on the ratepayers of Palmerston North, and therefore this has been given the highest weighting. Whilst the operational and maintenance costs will be an increase on the existing, the difference between the options of the effect on ratepayers is expected to be less and therefore it has been given the lowest weighting. These weightings will be confirmed as part of the Multi-Criteria Assessment workshop.

1.3 Assumptions and Comparative Cost Estimating Information applied in the assessment

1.3.1 General

- Proposed capital costs all on Day One (2025). Possible deferrals[1] for options R2(b), L+R(b), L+R(e) and O+L are covered in Table 6.
- 35-year NPV assessment. This is based on the duration of the consent sought.

[1] Deferrals consist of staging of specific treatment and land components applicable for certain options resulting in possible initial cost savings.

- 6% discount rate has been used through for the option development in the longlist and shortlist phases. It is noted Treasury now recommends a 5% discount rate for infrastructure projects https://www.treasury.govt.nz/information-and-services/state-sector-leadership/guidance/financial-reporting-policies-and-guidance/discount-rates. Changing the discount rate to 4% and 8% increased or decreased the NPV between 3 - 10% higher and 2 - 7% lower respectively for the options, with the greatest change for the River with enhanced treatment options. The level of change was dependent on operational and maintenance costs and the return received from crops/forestry for the option.
- Comparative estimated costing information has been completed under the following categories – capital, O&M and NPV.

1.3.2 Capital

The following are all as set out in Work Package 15.7 which sets out the comparative costs for each option.

1.3.2.1 Conveyance

- The method of bulk conveyance for all short list options comprises pump stations and pressure mains, with a long (approx. 2km) sea outfall for the ocean options. Where discharge is to the existing Tōtara Road river outfall, no conveyance cost has been included in the assessment, or any modifications to the existing outfall.
- Pipe alignments are within road corridors and are buried.
- Pipe reinstatement – 50% road and 50% verge.
- Distances to the land application sites are taken as to the centroid of potential sites, with the co-ordinate provided by PDP.
- No major river crossings are allowed for.
- A single pipeline is required.
- HDPE pipe material for diameters up to DN1200 - PE100 SDR13.6 PN12.5.
- GRP pipe material for diameters larger than DN1200 - GRP SN10,000.
- Minimum cover of 900mm and maximum depth to invert of 3m.
- Geotechnical conditions are assumed good (no running sands or rafting required), with minimal groundwater encountered.
- The 'Cost Data for Project Care Strategic Review' (2017) has been used for calculating pump station rates:
  - Pump Station Civil, Structural and Mechanical Formula is y =2410.7x + 2,000,000 where x = PS flowrate (l/s)
  - Pump Station Electrical Formula is y =815.62x + 212666, where x = PS power rating (kW)
- Pump stations are assumed to be submersible wet well type[2].
- Odour treatment has been excluded from the PS rates.
- The 'Cost Data for Project Care Strategic Review' (2017) has been used for calculating pipeline rates. The formula is y =2.2706x+336.58, where x = pipe diameter. These rates have then been compared to actual data from previous Stantec designed projects and the rate averaged across the data set.

[2] There may be potential for consideration of "inline" pumping as design is progressed.

- Pipe cost rates include all fittings, air valves, scour valves, hydrants etc.
- Rates have been inflated to 2019 rates in accordance with Reserve Bank of NZ CPI.
- Pipe diameters have been selected based on velocity between 1-1.5 m/s and total head per pump station < 60m. Pump stations spaced to achieve < 60m head.
- The topography is generally flat and falling overall to the ocean.
- Static head for pressure pipelines of 5m.
- Colebrook White roughness coefficient, Ks = 0.6mm.
- Fittings loss coefficient per pipeline, K= 6.5.
- Land is available free supply where required and therefore land purchase costs have not been included.
- Surge mitigation is accommodated by allowance within the pressure class of pipeline and including of air valves in pipe rates.
- Sediment and slime control by velocity management and therefore no allowance has been made for pigging installations.
- Pumps operate at 70% efficiency.
- Power costs have been calculated based on the projected operating hours for the pump stations.
- Power supply capital costs for cabling and associated infrastructure $200,000/km = $200/m.
- Power supply is from Bunnythorpe, due north of Palmerston North, at an approximate distance of 10 km.

1.3.2.2 Treatment

A full list of assumption made in the option development can be found in WP15.2 Shortlist Treatment Assessment Report. The following is a list of key assumptions:

- The existing Totara Road site is suitable for construction of upgrades to the WWTP process. This requires that:
- For the activated sludge options (R2(b), L+R(b)) the Bardenpho bioreactor would need to be constructed where the current sludge lagoons are located. This requires the sludge lagoons be desludged and appropriate works carried out to allow construction – costs associated with this have not been included.
- It is assumed that the existing inlet works will be re-used and new inlet works are not required, some modifications will be required to pass flows up to 2,200 L/s.
- New fine screens for the MBR upgrade will be located at the MBR, not in the inlet works.
- Industrial inputs from NZP can be redirected back to the inlet works without impact or issues with hydrogen sulphide release.
- For the activated sludge processes an interstage pump station will be required following the PSTs.
- Further hydraulic analysis of flows through the process have not been considered at this assessment stage.
- No costs associated with seismic strengthening of any of the existing structures are included.
- Existing PSTs (with supplementation) and digesters can continue to be used throughout the project life.
- Site power supply is assumed to be a nominal cost on a comparative basis.
- Instrumentation and control costs based on process requirements have been included.
- New UV Unit will be required for all options.

1.3.2.3 Land Application

The following general assumptions have been made:

- Management of odour is not expected for biologically treated wastewater. Any objectionable odour can be managed by flushing irrigation lines after use with fresh water.
- Aerosol migration beyond the boundary can be managed with buffer zones. Management practices such as increased buffers downwind of the dominant wind direction or postponing irrigation of boundary paddocks during high winds could be used.
- Land irrigation of wastewaters elevated in sodium can result in dispersal of clay particles, which can reduce soil infiltration rates. This is typically managed with applications of gypsum or lime.
- Heavy metals and other pollutants can accumulate in topsoil, triggering guideline values for contaminated land. This is unlikely for biologically treated wastewater.
- Key Receiving environments for Floodplain Based Options: Primary = shallow groundwater system. Secondary = Manawatu River and nearby tributaries/drains. Potential water quality effects of are expected to be manageable for all options, but require further confirmation.
- Key Receiving environments for Coastal Forestry Options: Primary = shallow groundwater system. Secondary = foreshore seepage zone (seaward) and nearby tributaries/drains/lakes (landward). Potential water quality effects of are expected to be manageable for all options, but require further confirmation.
- Depending on placement, potential for some third-party water takes/users to be affected (beyond the assumed 30% buffer zones), but mitigation options available e.g. deepen borehole
- Land cost assumes purchase of full land area required (including buffer allowance).
- Inland locations L+R(a), L+R(d), and Dual R+L: land costed at $50,000 /ha. This is based on Feb 2019 land value estimates for Shannon-Opiki and Moutoa Floodplain. Estimates obtained from four local valuers/rural agents.
- Coastal Locations L+R(b), L+R(e), O+L (Loc 2): land costed at $10,000 /ha due to reduced level of forestry at this location (does not include an allowance for forestry value). Actual valuations of forestry are required to provide more accurate Forestry costs. Potential ETS liabilities are forest dependent and have not been included.
- Nitrogen leaching assessment for pastoral sites assumes a yield of 10,000 kg DM/ha/yr with no additional nitrogen fertiliser applications
- Nitrogen leaching assessments for forestry sites assume harvesting and replanting every 25 years (i.e. typical commercial forestry operation), 100 kg N/ha/yr uptake September to April, no uptake May to August.
- Nitrogen leaching assessments for forestry sites assume 20 kg N/ha/yr is an acceptable level of leach due to limited foreseen environmental effect.
- Assessment of phosphorus and heavy metal concentrations in treated wastewater suitable for rapid infiltration are excluded.
- Nitrogen concentrations and leaching assessments relate to the land application scheme only, and rapid infiltration is excluded (as not considered applicable to land application, rather is a direct discharge).

- Land purchase costs are not based on the purchase of full parcels. There is potential slightly larger area may need to be purchased to fit the required land area onto existing parcels.
- Main receiving environment for the Rapid Infiltration Basin Systems (RIBS) area is the shallow groundwater system and Manawatū River. Potential water quality effects are expected to be manageable.
- Unlikely to be many third-party groundwater users effected by RIBs, given the assumption that PNCC have purchased the land.
- Management of RIB groundwater mounding is a key component that requires further investigation and assessment to properly quantify.
- No present allowance for potential archaeological aspects
- Assumed works could be completed without reducing the existing flood mitigation ability.
- Return on forestry products as per PDP land usage report A031092070R001.
- Where relevant - Land cost assumes purchased land area for RIBS and storage facility, and includes identified buffer zone (in all directions).
- Where relevant - Land costed at $50,000 /ha. This is based on Feb 2019 land value estimates for Tiakiahuna - Longburn. Estimates obtained from 4 local valuers/rural agents.

The following is a list of options, key assumptions and comments applicable to each option:

Table 1-1 Land application key assumptions and comments

Option	Variant	Land Application Scheme & Key Infrastructure	Land Area	Key Assumptions / Option Comments / Notes
1: R2(b)	River discharge with enhanced treatment	-	-	-
	River discharge with enhanced treatment, and a small % to land	• Irrigation to land when the flow in the Manawatū River is below 37.5 m^3/s, 75% ADWF (22,500 m^3/d) to land. All other treated wastewater flows will be discharged to the River. • A significant proportion of the scheme is located in a flood area so the irrigation will all be via k-line irrigators (50%) and centre pivot (50%). • 40,000 m^3 active volume onsite storage facility (lined), lagoon area 1 ha, 4m operational depth + 1m freeboard.	Active Irrigation Area = 470 ha Total Area (Inclusive of 30% Buffer) = 670 ha	• Commercial cut and carry pastoral scheme, with average annual return on product of $2,000/ha/yr (as per PDP land usage report).

Option	Variant	Land Application Scheme & Key Infrastructure	Land Area	Key Assumptions / Option Comments / Notes
2: Dual R+L	Two river discharge points and a small % to land	• Irrigation to land when the flow in the Manawatū River is below 37.5 m3/s, 100% of AWDF (30,000 m^3/d). All other treated wastewater flows will be discharged to the River.	Active Irrigation Area = 680 ha Total Area (Inclusive of 30% Buffer) = 970 ha	• Irrigation to land when the flow in the Manawatū River is below 37.5 m^3/s, 100% of AWDF (30,000 m^3/d). All other treated wastewater flows will be discharged to the River.
3: L + R (a)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	• Irrigation to land on days when the River flow is below the 97th percentile or other exceptional circumstances, on all other days the treated wastewater will be discharged to the River. • Centre pivot irrigators (80% of area) with solid set irrigators in between (20% of area). • 160,000 m^3 active volume onsite storage facility (lined), lagoon area 4 ha, 4m operational depth + 1m freeboard. • Rapid Infiltration with a capacity of 60,000 m^3/day, with an average usage in the range of 10-20 days per year.	Active Irrigation Area = 2,250 ha Total Area (Inclusive of 30% Buffer) = 3,215 ha	• Commercial cut and carry pastoral scheme, with average annual return on product of $2,000/ha/yr (as per PDP land usage report).
3: L + R (b)	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	• Irrigation to land on days when the Manawatū River flow is below the 97th percentile or other exceptional circumstances, on all other days the treated wastewater will be discharged to the River. • Solid set irrigation. • 160,000 m^3 active volume onsite storage facility (lined), lagoon area 4 ha, 4m operational depth + 1m freeboard. • Rapid Infiltration with a capacity of 50,000 m^3/day with an average usage in the range of 10 days per year.	Active Irrigation Area = 1,550 ha Total Area (Inclusive of 30% Buffer) = 2,260 ha	• Commercial forestry scheme harvested in Y26-30. • Emissions trading scheme income would be returned at Y18 ($500/ha/yr), has been included in income for Y26-30.

Option	Variant	Land Application Scheme & Key Infrastructure	Land Area	Key Assumptions / Option Comments / Notes
4: L+R (d)	45 % applied to an inland land application site and a river discharge for the remainder of the time	• Irrigation to land on days when the flow in the Manawatū River is below 80 m^3/s, except when the wastewater flow is above the 97th percentile or other exceptional circumstances. On all other days the treated wastewater will be discharged to the River. • Centre pivot irrigators (80% of area) with solid set irrigators in between (20% of area). • 60,000 m^3 active volume onsite storage facility (lined), lagoon area 1.5 ha, 4m operational depth + 1m freeboard. • Rapid Infiltration with capacity of 15,000 m^3/day, with an average usage of 2 days per year.	Active Irrigation Area = 1,220 ha Total Area (Inclusive of 30% Buffer) = 1,740 ha	• Commercial cut and carry pastoral scheme, with average annual return on product of $2,000/ha/yr (as per PDP land usage report).
	55 % applied to an inland land application site and a river discharge for the remainder of the time	• Irrigation to land on days when the flow in the Manawatū River is below 62.2 m^3/s, except when the wastewater flow is above the 97th percentile or other exceptional circumstances. On all other days the treated wastewater will be discharged to the River. • Centre pivot irrigators (80% of area) with solid set irrigators in between (20% of area). • 45,000 m^3 active volume onsite storage facility (lined), lagoon area 1.5 ha, 4m operational depth + 1m freeboard. • Rapid Infiltration with capacity of 15,000 m^3/day, with an average usage of 2 days per year.	Active Irrigation Area = 1,000 ha Total Area (Inclusive of 30% Buffer) = 1,430 ha	• Commercial cut and carry pastoral scheme, with average annual return on product of $2,000/ha/yr (as per PDP land usage report).

Option	Variant	Land Application Scheme & Key Infrastructure	Land Area	Key Assumptions / Option Comments / Notes
4: L+R (e)	45 % applied to a coastal land application site and a river discharge for the remainder of the time	• Irrigation to land on days when the flow in the Manawatū River is below 80 m^3/s, except when the wastewater flow is above the 97th percentile or other exceptional circumstances. On all other days the treated wastewater will be discharged to the River. • Solid set irrigation. • 60,000 m^3 active volume onsite storage facility (lined), lagoon area 1.5 ha, 4m operational depth + 1m freeboard. • Rapid Infiltration with capacity of 15,000 m^3/day, with an average usage of 1 day per year.	Active Irrigation Area = 2,180 ha Total Area (Inclusive of 30% Buffer) = 3,110 ha	• Commercial forestry scheme harvested in Y26-30. • Emissions trading scheme income would be returned at Y18 ($500/ha/yr), has been included in income for Y26-30.
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	• Irrigation to land on days when the flow in the Manawatū River is below 62.2 m^3/s, except when the wastewater flow is above the 97th percentile or other exceptional circumstances. On all other days the treated wastewater will be discharged to the River. • Solid set irrigation. • 50,000 m^3 active volume onsite storage facility (lined), lagoon area 1.5 ha, 4m operational depth + 1m freeboard. • Rapid Infiltration with capacity of 15,000 m^3/day, with an average usage of 1 day per year.	Active Irrigation Area = 1,800 ha Total Area (Inclusive of 30% Buffer) = 2,570 ha	• Commercial forestry scheme harvested in Y26-30. • Emissions trading scheme income would be returned at Y18 ($500/ha/yr), has been included in income for Y26-30.
6: Ocean	Ocean discharge, with a small % to land	• Irrigation to land for an average of 50% of the year (nominally Nov to Apr), of 15,000 m^3/d (50% ADWF) except when the wastewater flow is above the 97th percentile or other exceptional circumstances. All other treated wastewater flows will be discharged to the River. • Solid set irrigation. • 10,000 m^3 active volume onsite storage facility (lined), lagoon area 0.5 ha, 3m operational depth + 0.5m freeboard.	Active Irrigation Area = 860 ha Total Area (Inclusive of 30% Buffer) = 1,230 ha	• Commercial forestry scheme harvested in Y26-30. • Emissions trading scheme income would be returned at Y18 ($500/ha/yr), has been included in income for Y26-30.
	Ocean discharge	-	-	-

1.3.3 Operations and Maintenance

1.3.3.1 General

- All costs are over a 35-year period as this is the duration of the consent expected to be sought.
- Population growth is based on and extrapolated from the “Hybrid population project for Palmerston North (September 2017)”.
- Population growth from 2048 onwards is assumed to be a 0.3% growth annually.
- Year 1 for O&M starts from 2026 and ends in 2060.

1.3.3.2 Conveyance

- Annual maintenance cost is 1.5% of capital cost.
- Operator labour cost is assumed to be minimal, remain the same throughout the 35-year period and is not treatment level specific.

1.3.3.3 Treatment

The following general assumptions have been made:

- Lift pumps, interstage pumps, a recycle, blowers, carbon dosing, alum dosing, UV power and sludge costs are affected by population growth.
- Annual maintenance cost is 1.5% of capital cost.
- Operator labour cost is assumed to be the same as the current operational cost of treatment plant.
- Power cost is assumed to be $0.13kWh.
- Power for lift pump operation is based on 100kW pumps running 50% of time based on current lift pump upgrade operation.
- Power for inlet screens is 1kW running 75% of the time based on Boneo operation costs.
- Power for primary tanks is 3kW running 40% of the time.
- Power for interstage pump station is based on 100kW pumps running 50% of the time based on current lift pump upgrade operation.
- Power for clarifier return activated sludge (RAS) pumps is 16kW running 100% of the time.
- Power for UV disinfection is 46kW running 100% of the time.
- Cost for bulbs and ballast are assumed to be $40,000 per annum.
- Cost for sludge disposal is assumed to be between $66,000 to $180,000 per annum depending on the option.

1.3.3.4 Land application

- Land application operations is assumed to not be affected by population growth
- Land application income for coastal forestry sites reflects when trees are harvested and is estimated per ha revenue with timber harvested after 25 years of growth and harvest revenue is spread across 5 years from Years 26 – 30 following the establishment of the scheme.
- Land application income for inland cut and carry sites is assumed to happen annually.

- Emissions trading scheme (ETS) income should be received at Year 18. However, for the cost estimates prepared for the WP15.7 BPO Option Summary Report_Oct 2020_Issue (October 2020), this income was included in the revenue from Years 26-30. As it made little difference to the Net Present Value, and no difference to the scoring, the numbers have been left as per prepared for the October 2020 Summary report

The following is a list of options, key assumptions and comments applicable to each option:

Table 1-2 WWTP Operations and Maintenance key assumptions and comments

Option	Variant	Key Assumptions
1: R2(b)	Without land application With land application	• Power for A Recycle is assumed to be 43kW pumps running 100% of the time. • Power for WAS pumps are 14kW running 13% of the time. • Membrane replacement is assumed to be $570,000 per annum. • Membrane power is assumed to be 60kW running 58% of the time. • Membrane cleaning chemical is assumed to be $1,150,000 per annum. • Carbon dosing chemical is assumed to be 200m^3/year at $319 per m^3 • Alum dosing is assumed to be $1,747 per m^3 of alum
2: Dual R+L		• Alum dosing is assumed to be $1,747 per m^3 of alum • Power for A Recycle is assumed to be 29kW pumps running 100% of the time. • WAS Pumps are assumed to be 5kW running 13% of the time.
3: L + R (a)	Inland land application site	• Pond aeration power is 300kW running 100% of the time
3: L + R (b)	Coastal land application site	• Alum dosing is assumed to be $1,747 per m^3 of alum • Power for A Recycle is assumed to be 29kW pumps running 100% of the time. • WAS Pumps are assumed to be 5kW running 13% of the time.
4: L+R (d)	Inland land application site, with less land application Inland land application site, with more land application	• Alum dosing is assumed to be $1,747 per m^3 of alum • Pond aeration power is 300kW running 100% of the time

Option	Variant	Key Assumptions
4: L+R (e)	Coastal land application site, with less land application	• Alum dosing is assumed to be $1,747 per m^3 of alum • Pond aeration power is 300kW running 100% of the time
	Coastal land application site, with more land application	
6: Ocean	With land application	• Pond aeration power is 300kW running 100% of the time
	Without land application	-

1.3.4 Renewals

Renewals have been included in the operations and maintenance costs. Renewals included are outlined below

1.3.4.1 General

- Renewal peaks have been spread out by averaging the significant renewal costs in Years 10, 15, 20, 25 and 30 by three (one year before and one year after expected renewal)
- For Dual R+L, renewal peaks for wetland bed replacement have been spread out by averaging the renewal costs every three years (one year before and one year after expected renewal)
- Renewals estimate excludes P&G, contingency and professional services
- Land application infrastructure renewals assumed at Year 15, 20 and 30

1.3.4.2 Conveyance

- Renewals every 20 years for electrical and conveyance pumps
- Renewal cost of pumps is assumed to be 50% of the total civil capital cost of the pump station
- Renewal for the electrical component assumes a like for like replacement
- Assume that with regular maintenance, no components of the dissipator and outfall will be required to be renewed

1.3.4.3 Treatment

- Yearly renewals for membranes and pond aeration
- Renewal every 7 years for diffusers
- Renewals every 20 years for a recycle and clarifiers

- Renewals every 25 years for lift pumps, screens, grit removal, primary tanks, interstage pumps and blowers
- Assumed that only the vertical flow wetland requires renewals with all other wetlands only requiring operation and maintenance

1.4 Capital, Operational and Maintenance and NPV Indicative Comparative Costs

Tables 1-3 to 1-4 set out the capital, O&M and NPV indicative comparative costs for each option. O&M costs in Table 4 are listed as Year 1 for clarity only, the O&M costs for each option will change annually due, e.g. due to growth, renewals required, wetland replanting required etc.

Table 1-3 Overall Indicative Comparative Costs

Option	Variant	Capital (Total, $M)	Operational & Maintenance (Y1, $M)[3]	NPV ($M)
1: R2(b)	River discharge with enhanced treatment	$193	$7	$292
	River discharge with enhanced treatment, and a small % to land	$290	$8	$399
2: Dual R+L	Two river discharge points and a small % to land	$272	$4	$364
3: L + R (a)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	$399	$3	$394
3: L + R (b)	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	$502	$7	$602
4: L+R (d)	45 % applied to an inland land application site and a river discharge for the remainder of the time	$230	$5	$289
	55 % applied to an inland land application site and a river discharge for the remainder of the time	$256	$5	$312
4: L+R (e)	45 % applied to a coastal land application site and a river discharge for the remainder of the time	$360	$3	$411
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	$388	$4	$454

[3] This does not include income from land application schemes and is the estimate for Y1 of operation

Option	Variant	Capital (Total, $M)	Operational & Maintenance (Y1, $M)[3]	NPV ($M)
6: Ocean	Ocean discharge, with a small % to land	$408	$5	$487
	Ocean discharge	$343	$5	$415

Table 1-4 Indicative Comparative Operational and Maintenance Costs (including Renewals)

Option	Variant	Year 1 ($M)	Average per annum across 35 years ($M)	Total ($M)	NPV ($M)
1: R2(b)	River discharge with enhanced treatment	$7	$7	$239	$98
	River discharge with enhanced treatment, and a small % to land	$7	$8	$269	$110
2: Dual R+L	Two river discharge points and a small % to land	$5	$6	$225	$92
3: L + R (a)	97 % applied to an inland land application site, and a discharge to river in exceptional circumstances	-$1[4]	-$0.1[4]	-$4[4]	-$5[4]
3: L + R (b)	97 % applied to a coastal land application site, and a discharge to river in exceptional circumstances	$7	$6	$220	$100
4: L+R (d)	45 % applied to an inland land application site, and a river discharge for the remainder of the time	$4	$4	$147	$59
	55 % applied to an inland land application site, and a river discharge for the remainder of the time	$3	$4	$139	$56
4: L+R (e)	45 % applied to a coastal land application site, and a river discharge for the remainder of the time	$3	$3	$96	$51

[4] Option 3: L+R (a) returns negative overall operational and maintenance costs as a result of the high land income.

Option	Variant	Year 1 ($M)	Average per annum across 35 years ($M)	Total ($M)	NPV ($M)
	55 % applied to a coastal land application site, and a river discharge for the remainder of the time	$4	$4	$124	$65
6: Ocean	Ocean discharge, with a small % to land	$5	$5	$180	$79
	Ocean discharge	$5	$5	$177	$72

Table 1-5 sets out the possible deferrals and associated cost savings for each option with the exception of the Ocean only option which does not have components that can be deferred. For the land application schemes this does not include deferment of land purchase costs, only the land application infrastructure. It should also be noted the land application schemes have been designed for a 50-year life, and there is deferment of some costs until Year 40 (past the life of the expected sought consent).

Table 1-5 Possible deferrals and associated savings

Option	Variant	Component	**Initial ($M)**	Year 10 ($M)	Year 20 ($M)	Year 30 ($M)	Year 40 ($M)	Deferred saving ($M)
1: R2(b)	River discharge with enhanced treatment	MBR AS Process (Bioreactor and membrane)	$52	-	-	$12	-	$4.5
	River discharge with enhanced treatment, and a small % to land	MBR AS Process (Bioreactor and membrane)	$52	-	-	$12	-	$4.5
		Land application infrastructure	$43	$1	$1	$1	$1	$2

Option	Variant	Component	**Initial ($M)**	Year 10 ($M)	Year 20 ($M)	Year 30 ($M)	Year 40 ($M)	Deferred saving ($M)
2: Dual R+L	Two river discharge points and a small % to land	Chemical clarifier	-	$2	-	-		$1.4
		Land application infrastructure	$48	$1	$1	$1	$1	$1
3: L + R (a)	97 % applied to an inland land application site, and a discharge to river in exceptional circumstances	Land application infrastructure	$208	$3.5	$3.5	$3.5	$3.5	$10
3: L + R (b)	97 % applied to a coastal land application site, and a discharge to river in exceptional circumstances	Conventional AS Process (Bioreactor and clarifier)	$38	-	-	$10	-	$6
		Land application infrastructure	$71	$3.5	$3.5	$3.5	$3.5	$2.5
4: L+R (d)	45 % applied to an inland land application site, and a river discharge for the remainder of the time	Chemical clarifier	-	$2	-	-	-	$1.3
		Land application infrastructure	$92	$1.5	$1.5	$1.5	$1.5	$1.5
	55 % applied to an inland land application site, and a river discharge for the remainder of the time	Chemical clarifier	-	$2	-	-	-	$1.4
		Land application infrastructure	$111	$2	$2	$2	$2	$2
4: L+R (e)	45 % applied to a coastal land application site, and a river discharge for the remainder of the time	Conventional AS Process (Bioreactor and clarifier)	$38	-	-	$10	-	$6
		Land application infrastructure	$74	$4	$4	$4	$4	$5
	55 % applied to a coastal land application site, and a river discharge for the remainder of the time	Conventional AS Process (Bioreactor and clarifier)	$38	-	-	$10	-	$6
		Land application infrastructure	$90	$4.8	$4.8	$4.8	$4.8	$4.6

Option	Variant	Component	**Initial ($M)**	Year 10 ($M)	Year 20 ($M)	Year 30 ($M)	Year 40 ($M)	Deferred saving ($M)
6: Ocean	Ocean discharge, with a small % to land	Conventional AS Process (Bioreactor and clarifier)	$38	-	-	$10	-	$6
		Land application infrastructure	$35	$1.8	$1.8	$1.8	$1.8	$1.6
	Ocean discharge	-	-	-	-	-	-	-

1.5 Assessment table

Table 1-6 sets out the preliminary assessment of the options by the authors using the approach detailed in Section 1.2, with weightings of 10, 8 and 9 given to Capital, O&M and NPV respectively.

Table 1-6 Draft Financial Criteria Scores

Option	Variant	Capital Score	Operational and Maintenance Score	NPV Score	Draft Total Score for MCA
1: R2(b)	River discharge with enhanced treatment	3.5	1.5	3.1	2.8
	River discharge with enhanced treatment, and a small % to land	2.7	1.0	2.3	2.1
2: Dual R + L	Two river discharge points and a small % to land	2.8	2.8	2.6	2.7
3: L+R (a)	97 % applied to an inland land application site, and a discharge to river in exceptional circumstances	1.8	3.2	2.4	2.4
3: L+R (b)	97 % applied to a coastal land application site, and a discharge to river in exceptional circumstances	1.0	1.5	1.0	1.1
4: L + R (d)	45 % applied to an inland land application site, and a river discharge for the remainder of the time	3.2	2.6	3.1	3.0

Option	Variant	Capital Score	Operational and Maintenance Score	NPV Score	Draft Total Score for MCA
	55 % applied to an inland land application site, and a river discharge for the remainder of the time	3.0	2.5	2.9	2.8
4: L + R (e)	45 % applied to a coastal land application site, and a river discharge for the remainder of the time	2.1	3.3	2.3	2.5
	55 % applied to a coastal land application site, and a river discharge for the remainder of the time	1.9	2.7	2.0	2.2
6: Ocean	Ocean discharge, with a small % to land	1.7	2.3	1.8	1.9
	Ocean discharge	2.3	2.6	2.2	2.4

Note: Option 5, which involved a mix of groundwater discharge and land application, was removed from the short list during the short list development phase of the project.

Growth & Economic Development Comparative Assessment of Short-listed options

1.1 Introduction

This report sets out the 'Growth and Economic Development' comparative assessment of the short-listed options for the Palmerston North Wastewater BPO project ("Nature Calls").

The report was prepared by:

- Melaina Voss, Wastewater BPO Project Manager for Palmerston North City Council. Melaina has a Bachelor of Planning from the University of Auckland, is a Full Member of the New Zealand Planning Institute and 18+ years' experience in resource management planning and strategic planning for growth.
- Richard Peterson (Reviewer). Richard has a Master of Regional and Resource Planning degree from the University of Otago, is a Full Member of the New Zealand Planning Institute and has 25+ years planning experience.

1.2 Criterion and scoring approach

The overall scoring is as per the table below. The scores were generated from how well the option aligned with the sub-criteria. The final score has been reached by calculating an average across the two sub criteria (as outlined in the table below).

Criterion	Description	1	2	3	4	5
Growth and Economic Development	The degree to which the options will: • Support the population and economic growth anticipated for the City by Council? • Support / restrict further up-scaling to accommodate a sub-regional scheme?	Low degree	Low – Medium degree	Medium degree	Medium – High degree	High degree

1.3 Approach to the assessment

As set out in the MCA method report, the Growth and economic development description is the following:

- The degree to which the option supports the population and economic growth anticipated for the City by Palmerston North City Council; and
- The degree to which the option supports or restrict further up-scaling to accommodate regional growth?".

An option's draft score for growth and economic development has been developed by first scoring each of the two sub-categories separately. An overall score was then given by averaging these two scores, with equal weighting being given to the two categories.

1.3.1 Supporting population growth and economic development

- Ability to provide a solution that meets population growth targets for 35 years or greater
- Ability to secure sufficient land or capacity of receiving environment for the projected population growth targets (35 years) or greater
- Level to which the discharge impacts on a receiving environment that contributes to the region's economic development

1.3.2 Accommodating a sub-regional scheme

- Ability to accommodate additional flows and loads from neighbouring councils and industry
- Proximity of council infrastructure to connecting wastewater source
- Capacity within the receiving environment to accommodate additional flows and loads over the consent duration

1.4 Assumptions applied in the assessment

As the exact location of the proposed discharge is yet to be confirmed, broad assumptions have been made with respect to the potential adverse effects on growth and development for this Option.

It is assumed that the land suitable for land-based discharge is currently used for agricultural purposes ie within the fluvial soil areas or coastal sand country, and does not reduce the capacity of the regional to accommodation population growth.

The design and operation of any option will account for future population growth within the term of the consent (35 years) and until the life of the asset is designed to (50 years), as defined in the technical work completed by Stantec to date. This is including pipe, treatment plant and land application area sizing.

If Council is unable to secure the land via willing buyer process and/or leasing arrangements land will be pursued via the Public Works Act and the land is available for this process.

Growth and development within the areas of Palmerston North, Horowhenua and the Manawatu Regions, will likely occur on the boundary of existing urban limits/boundaries and not likely to occur within rural areas that immediately adjoin land application sites.

There are low, medium, and high forecasted population growth rates for Palmerston North, in which a medium growth rate has been adopted. The Council has determined that there will be both residential and light industry (commercial) growth and limited growth in wet industry is expected. This therefore will not increase wastewater contaminant loads significantly within the consent duration of 35 years.

On the basis that the exact location of the outfall to the Ocean is yet to be confirmed, however the assumption is the location is on the west coast approximately 30km from the existing WWTP.

Consideration of the impact of COVID on New Zealand and the Manawatu Region is not yet known on growth or the economy. Consideration is needed on the potential impacts of the proposal on the region’s economy and rates of growth in reflect of COVID. This may be assessed once the preferred option is identified and as part of the Assessment of Environmental Effects stage of the Project. This should focus on the potential impact of the BPO (if a land-based solution is adopted) on loss of agricultural land use and subsequent economy losses. A revision of the city’s growth rates may also be necessary due to the movement of people within New Zealand and a reduction in travel in and out of New Zealand.

1.5 Assessment table

The following table sets out the preliminary assessment of the options by the authors. This will be used as a starting point for discussion at the MCA workshop. The final MCA assessment and score may therefore differ from what is set out below.

Option	Variant	Growth & Economic Development Assessment	Growth & Economic Score	Sub-Regional Scheme Assessment	Sub-Regional Scheme Score	Draft MCA score
1: R2(b)	River discharge with enhanced treatment	- The Manawatu River contributes to the region's tourism, traversing two territorial authorities to the north and south of Palmerston North, and all three currently discharging treated wastewater into the Manawatu River. There are clear policy drivers at National level to improve the quality of Rivers. - The Manawatu River is a feature for the region's tourism and environmentalists. Activities include passive and active recreation, camping, birdlife and planting preservations and recreational fishing. Organised sporting events ie canoeing and fly-fishing also occur regularly along the stretch of the River. Discharging of wastewater will continue to limit the ability for recreation and tourism activities to occur, constraining the ability for economic development and growth of sectors along/associated with the River. - Palmerston North City Council has clear growth targets for the city, including economic development strategy that targets sectors. The solution must meet these targets to achieve the strategic goals for economic development. - There is limited capacity within the treatment regimens to decrease contaminants as the increase in wastewater occurs from growth. Therefore, as the discharge reaches contaminate maximums in River catchment, the ability to accommodate future growth may be limited.	2	The river has limited capacity for the proposed wastewater discharge. A proposed regional scheme would limit the capacity for growth of the city, unless substantial increases in the treatment regime were achieved to manage nutrients entering the River. The option includes technology that is relatively advanced and therefore opportunities for further treatment advances are limited.	2	2
	River discharge with enhanced treatment, and a small % to land	As per Option1 R2(b); however reduced impacts on River from: - The land area may provide some relief to the effects on the River however will retain the same perceived issues. - Potentially allows for more growth, compared to Option 1 of all to River, as land can be expanded to accommodate this.	3	As per above, however with the introduction of land, this may allow for increased flows and loads associated with a regional scheme. The potential for a scheme is still limited due to the maximum limits of nutrients that need to be achieved in the River. However, with the addition of land, the potential for additional growth is supported.	2	2.5
2: Dual R + L	Two river discharge points and a small % to land	As per Option 1 R2(b) with land.	3	As per Option 1 R2(b) with land.	2	2.5
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	- As the exact location of the proposed discharge is yet to be confirmed and therefore, broad assumptions have been made with respect to the potential adverse effects on growth and economic development for this option. It is assumed that the majority of the land suitable for land-based discharge is currently used for the purpose of agriculture. This land would likely convert to a cut and carry operation and any form of dairy, intensive beef or sheep farming, would be unlikely to occur due to perceived issues with treated wastewater being discharged to land. This has the potential to impact on economic development within the region given the land area necessary. - - Land that could provide for the City's growth is used for the application of the City's wastewater and buffer areas therefore loss of developable land and land is the vicinity perceived as not desirable for residential living.	2	Large areas of land already required for PNCC alone which may be problematic (as per growth assessment). This is further constrained with increased flows and loads from neighbouring Councils, increasing the necessary land area.	2	2

Option	Variant	Growth & Economic Development Assessment	Growth & Economic Score	Sub-Regional Scheme Assessment	Sub-Regional Scheme Score	Draft MCA score
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	- As the exact location of the proposed discharge is yet to be confirmed and therefore, broad assumptions have been made with respect to the potential adverse effects on growth and economic development for this Option. It is assumed that most of the land suitable for land-based discharge is currently used for forestry or is vacant coastal land. This land would likely convert to a forestry operation. This has the potential to impact on economic development in a positive way in that there is a new/added source of economy brought to the region. - Land provides coastal amenity, which is no longer accessible, impacting on the region's tourism. This is however a limited area of land that will be required and unlikely to have a significant adverse effect on the region's overall economy. - Land that could provide for the City's growth is used for the application of the City's wastewater and buffer areas therefore loss of developable land and land is the vicinity perceived as not desirable for residential living.	3	As above (for fluvial soils)	3	3
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	Issues are as presented in Option 1 and 3, however are less in scale given the land area is reduced and the volume of wastewater to the river is less. Area of land may be easier to acquire due to the reduced sizes required.	3	In line with the assessment on growth, this option also provides an opportunity to increase flows and loads where the land area may be increased to accommodate the addition of neighbouring councils and/or industry wastewater. On the basis that the land required is less from the outset, there may be greater opportunity to increase land utilised in a staged way over time. There are still limitations on this availability however to acquire land and capacity within the River to take on nutrients. Enhanced treatment or additional land, would be necessary to achieve any significant increase in wastewater flows and loads from the planned growth.	3	3
	55 % applied to an inland land application site and a river discharge for the remainder of the time	As above for 45%	3	As above for 45%	3	3
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	As above L+R(b). However on the basis the land area is larger than the fluvial soils requirement and there is limited coastal land available, this option may be more constrained in accommodating growth.	2	As above for 4 L+R(b) However on the basis the land area is larger than the fluvial soils requirement and there is limited coastal land available, this option may be more constrained in accommodating growth.	2	2
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	As above for L+R(b).	2	As above for L+R(b)	2	2
6: Ocean	Ocean discharge, with a small % to land	As raised in the matters raised in Option R2(a), an outfall and discharge to the Ocean has the potential to impact on commercial activities occurring in the Region along the west). The activities that occur along coastline include: - Commercial fishing (and recreational)	4	Options provides the greatest assimilative capacity to accommodate wastewater discharges, including increased volumes from a sub-regional scheme on the basis the pipeline will provide an opportunity to connect in additional wastewater from neighbouring councils and/or industry. It is not yet confirmed if the wastewater is treated prior to connecting in or	4	4

Option	Variant	Growth & Economic Development Assessment	Growth & Economic Score	Sub-Regional Scheme Assessment	Sub-Regional Scheme Score	Draft MCA score
		- Water sports such as surfing, windsurfing and swimming that attracts tourists and community to the area - Passive recreation along the shoreline such as walking, motocross and 4WD along the shoreline and into the dunes - Bird watching (along the shoreline) - Visitors spend in the local shops As the discharge will occur away from the shoreline, there may be no immediate adverse effect on the ability to carry out activities along the shoreline due to pipeline/outfall structures. However, a discharge of treated wastewater into the ocean has the potential to impact on ecosystems that support fish and shell fish industry, however this is limited (refer to environmental comparative assessment). This in turn may have an adverse affect on marketing/sale of commercial fishing activities given there is a perceived degradation of water quality. This also has the potential to impact on tourism. With that said, the option also provides the greatest opportunity for growth in wastewater volume and loads in comparison to the other options. This is given the ability for the receiving environment to be less sensitive that the River and is less constrained than the land options. The total land area is smaller than the other options and there is potentially an opportunity t increase this land area over time to also accommodate growth.		if it is to be treated at Totara Road prior to being piped to the discharge location.		
	Ocean discharge	As above.	4	As above.	4	4

Note: Option 5, which involved a mix of groundwater discharge and land application, was removed from the short list during the short list development phase of the project.

1.6 Assessment Summary

Option	Variant	Draft score
1: R2(b)	River discharge with enhanced treatment	2
	River discharge with enhanced treatment, and a small % to land	2.5
2: Dual R + L	Two river discharge points and a small % to land	2.5
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	2
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	3
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	3
	55 % applied to an inland land application site and a river discharge for the remainder of the time	3
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	2
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	2
6: Ocean	Ocean discharge, with a small % to land	4
	Ocean discharge	4

1 Technology and Infrastructure Comparative Assessment of Short-listed Options

1.1 Introduction

This report sets out the Technology and Infrastructure comparative assessment of the short-listed options for the Palmerston North Wastewater BPO project ("Nature Calls"). This report is to be used to inform the Multi-Criteria Assessment (MCA) of the shortlisted options.

The report was prepared by:

- Overall Assessment of options
    - Rita Whitfield – Stantec Graduate Civil Engineer
    - Anna Bridgman – Stantec Group Manager/ Senior Civil Engineer
    - Jim Bradley – Stantec Technical Specialist
- Assessment of treatment element of options
    - Michael Tan – Stantec Process Engineer
    - Andrew Slaney – Stantec Senior Process Engineer
- Assessment of land treatment element of options
    - Luke Wilkinson – PDP Environmental Engineer
    - Aslan Perwick – PDP Groundwater Service Leader

1.2 Criterion and scoring approach

The overall scoring is as per the table below. Each of the six sub-criteria were scored with regards to how well the option aligned with that sub-criteria. The overall draft score is an average of these five scores, rounded to the nearest 0.5, with each sub-criteria given equal weighting. Average has been used rather than the lowest score as it is not believed that any one of these sub-criteria is the governing factor in the selection of the BPO.

Criterion	Description	1	2	3	4	5
Technology and Infrastructure	Degree to which the option: • can be staged • is able to be constructed and operational within 5 years of the commencement of the consent • allows for resource recovery / beneficial re-use	Low degree of alignment with sub-criteria and/or High Operational	Low – Medium degree of alignment with sub-criteria and/or Medium-High	Medium degree of alignment with sub-criteria and/or Medium	Medium – High degree of alignment with sub-criteria and/or Low-Medium	High degree of alignment with sub-criteria and/or Low Operational

Criterion	Description	1	2	3	4	5
	• infrastructure can be up-scaled, prior to and post initial construction, to accommodate a sub-regional scheme • involves Operational Complexity • involves Operational Risk	Complexity and Risk	Operational Complexity and Risk	Operational Complexity and Risk	Operational Complexity and Risk	Complexity and Risk

1.3 Technology & Infrastructure Categories

1. Can be Staged
   a) Can be sequentially upgraded/modified, as required, to accommodate increases in flows and loads, and/or for possible revised more stringent discharge parameters to meet legislative requirements

2. Is able to be constructed and operational within 5 years of the commencement of the consent
   a) Materials are available
   b) Contractors have the experience in the forms of installation and development required
   c) Suitable land is available

3. Allows for resource recovery / beneficial re-use
   a) Includes the land use ‘cut and carry’ or forestry resource recovery options, and waste stream resource recovery at a high level.
   b) The wastewater treatment plant (WWTP) can operate as a “Product Factory” in line with previously considered resource recovery information on the project.
   c) Includes potential carbon credits from forestry land application sites

4. Infrastructure can be up-scaled, prior to and post initial construction, to accommodate a sub-regional scheme

5. Involves Operational/Technical Complexity
   a) Scheme complexity leading to potential operational problems
   b) Scheme maintenance requirements which can cause additional operational problem

6. Involves Operational Risk
   a) Power supply reliability – effect of outages and rapid changes to electricity pricing

b) Unexpected air contamination effects (odour, aerosol, spry drift etc)
c) Third party damage to infrastructure, e.g. digger hitting cables, pipes etc
d) Crop failure/contamination
e) Loss of market for land application products e.g. cut and carry products, forestry production
f) Unexpected future requirements in terms of emerging contaminants of concern/endocrine disrupting compounds

1.4 Assumptions applied in the assessment

- All infrastructure assets to be constructed as part of the preferred option would be to the design standards and local specifications required at the time of detailed design.
- Cost is not a constraining component in the constructability sub-category
- Land is available for the construction of the options, including pipelines, pump stations, treatment facilities, outfalls and land application.
- Ocean Outfall options are 2km long from the foreshore. Dispersion modelling would be completed if an ocean option is selected as the BPO to validate this assumption and to assist site selection.
- Ground conditions are suitable for construction of pipelines, pump stations and treatment facilities, and that soft foundations can be addressed through minor ground improvements such as raft foundations
- All materials and equipment would be available in stock or with have short lead times so as to not greatly affect construction timeframes.
- A conventional project delivery method will be used (consent, design, tender and then construct). Alternative delivery models should ultimately be considered, including alternative procurement methods to expedite construction.
- Construction timeline of 5 years includes agreement of land purchase. It has been assumed that designation would also de-risk this timeframe.
- The distribution infrastructure within the land application scheme will not be designed with future expansion to a regional scheme in mind, therefore future expansion may require pump station upgrades and/or the replacement of some distribution mains.
- Access to the land application scheme will be restricted, thus providing reasonable protection from third party damage to infrastructure.
- Risk to loss of market for forestry considered greater than the risk to the cut and carry schemes as the cut and carry crop can be replaced over one season, whereas the forestry is intended to be a 25-year investment.
- Any Emerging Contaminants in the wastewater stream that require control will be managed as part of the incoming wastewater management (e.g. tradewaste controls) and the wastewater treatment process and will not change the operation of the land application system.
- In general, the larger schemes are considered more complex to operate and therefore have a higher associated risk from loss of irrigation blocks due to malfunctions and/or mismanagement of the scheme.
- Irrigation blocks will be rotated so not all will be in use each day, therefore the system has inbuilt resilience to when some irrigation blocks cannot be used during maintenance or breakdowns.
- For the assessment on whether the schemes could be upscaled (over and above Palmerston North City Council growth allowance) if required, the assumption has been made that untreated wastewater will be piped to the plant from other regions.

- The increase in capacity required for a sub-regional scheme is approximately 30%, taking in Marton, Bulls, Halcombe, Ohakea, Sanson and Feilding.
- The assessment of ability to increase capacity for a sub-regional scheme is based on infrastructure only, and not the environmental limits of the receiving environment. This is being covered in other Comparative Assessments.

1.5 Assessment table

The following table sets out the preliminary assessment of the options by the authors. This will be used as a starting point for discussion at the MCA workshop. The final MCA assessment and score may therefore differ from what is set out below.

Where there are multiple variants of any option, factors which are common to all variants are listed in a row first.

Option	Variant	Can be staged	Constructable & Operational within 5yrs	Allows for Resource recovery	Can be Up-scaled	Operational / Technical Complexity	Operational Risk	Draft score
1: R2(b)	Generic for both variants	- The membrane trains of the Membrane Reactor (MBR) units are designed to be installed in batches which indicates the installation could be staged. However, the bio reactor tanks would need to be installed up front. - Revised discharge parameters to meet legislative requirements may require additional treatment processes	- Expect Local contractors to have the experience to construct required infrastructure. - Land purchasing is achievable within this time frame - Design of the required infrastructure is achievable in this timeframe - There is an extent which the option influences time frame, but all are predicted to be achievable	- Treatment level produces high quality treated wastewater which could be re-used for non-potable uses - Potential to recover struvite which would reduce but not eliminate alum dosing requirement. This requires a 5-stage process so additional infrastructure. - Retaining digestors would allow for energy recovery through biogas with carbon additions	- Additional membrane bioreactor components can be added to the treatment plant increasing capacity, with minimal space requirements, but will need significant additional upgrades for hydraulic capacity through the plant including inlet works replacement. - Additional flow will reduce capacity of wet weather storage in converted lagoons - Additional flow may require a lower SIN concentration be targeted, the ability to achieve this target will need to be considered.	- Significantly more complex due to cleaning and maintaining of membranes required, however this is automated. - Chemicals are required for cleaning - Fine screens also require cleaning and maintenance - Changing requirements for emerging contaminants of concern/endocrine disrupting compounds may affect treatment required, but this is the best suited plant type for removal of emerging contaminants.	- At risk of power failure but within WWTP site for operational repair - Additional chemicals required for cleaning. - Less risk of fluctuating treated wastewater quality, with physical barrier - More power required due to membranes therefore greater risk of fluctuations of operation costs, with an overall higher operation cost - Lesser risk of requiring treatment process upgrades due to environmental concerns due to high quality treated wastewater	
	River discharge with enhanced treatment				- Can only send treated wastewater to river, no options to send elsewhere	- Relatively simple system, pipeline within WWTP boundary - Only need to control discharge to one location, no need to consider alternatives. - Largest wetland scheme	- Reduced risk due to the minimal amount of infrastructure required, only one discharge point, but largest wetland scheme. - Discharge linked to upstream river quality and loading, this may result in environmental issues if upstream discharge increases or river flow decreases. This cannot be offset by discharge to land.	4.0
		4	5	3	4	3	4	
	River discharge with enhanced treatment, and a small % to land	- Irrigation infrastructure can be staged - Conveyance infrastructure staging would require dual mains (an additional cost) and staggered pump installation		- Option intent is to support commercial cut and carry crops complementary with discharge - Will be at a much smaller scale than Option 3 & 4 variants, therefore lesser potential for resource recovery/beneficial re-use, but cut & carry is a beneficial re-use - Nutrient resources within the wastewater stream are being actively recovered in agricultural product.	- Additional flow will reduce capacity of wet weather storage in converted lagoons - Acquiring additional land area considered to be (comparatively) easier than the larger options. - Irrigation system can be expanded. There may be 're-work' required during scaling up the distribution infrastructure if this has not accounted for in the initial design.	- Scheme is relatively simple, however does require flow split - Odour/drift etc needs to be managed by buffer zones, application methods and management of storage systems -This option is the smallest irrigation scheme within the BPO, so (comparatively) is considered the simplest to operate. - Crop harvesting will require contractor involvement as this	- Irrigation infrastructure and pipeline is potentially at risk from third party damage - Crop failure is a risk, can be managed with effective operations - Permanent loss of market for crops is considered unlikely - Irrigation blocks can be rotated which provides inherent resilience to partial breakdowns across the irrigation scheme - Power outages would affect pumping to scheme and	4.0

Option	Variant	Can be staged	Constructable & Operational within 5yrs	Allows for Resource recovery	Can be Up-scaled	Operational / Technical Complexity	Operational Risk	Draft score
				- To achieve equivalent production on the same land, the re-use of the wastewater stream inherently means that freshwater resources are being spared e.g. promotes freshwater allocation to be used elsewhere within the region.		will not be in the day to day operator's skill set.	irrigation system, but backup systems could control this	
		4	5	4	4	2	4	
2: Dual R+L	Two river discharge points and a small % to land	- Conveyance infrastructure staging would require dual mains (an additional cost) and staggered pump installation - Irrigation infrastructure can be staged - Revised discharge parameters to meet legislative requirements may require additional treatment processes	- Expect Local contractors to have the experience to construct required infrastructure. - Land purchasing is achievable within this time frame - Design of the required infrastructure is achievable in this timeframe - There is an extent which the option influences timeframe but all are predicted to be achievable	- Option intent is to support a commercial cut and carry crops complementary with discharge - Will be at a much smaller scale than Option 3 & 4 variants, therefore lesser potential for resource recovery/beneficial re-use. This will depend on the size and uptake of the market for biomass material. - Retaining digestors could allow for energy recovery through biogas with carbon additions - Nutrient resources within the wastewater stream are being actively recovered in agricultural product for proportion going to land. - To achieve equivalent production on the same land, the re-use of the wastewater stream inherently means that freshwater resources are being spared e.g. promotes freshwater allocation to be used elsewhere within the region.	- Will need significant additional upgrades for hydraulic capacity through the plant - Acquiring additional land area considered to be (comparatively) easier than the larger options. - Irrigation system can be expanded. There may be 're-work' required during scaling up the distribution infrastructure if this has not accounted for in the initial design. -Inlet works will need to be upsized and potentially replaced to accommodate additional flows. - Aerated lagoons have a limited organic loading capacity and this will limit the total capacity of the process.	- Scheme is relatively simple with shorter pipelines than options 3, 4 & 6 - Odour/drift etc to be managed by buffer zones, application methods and management of storage systems - This option is the second smallest irrigation scheme within the BPO, so (comparatively) is considered simpler to operate. - Crop harvesting will require contractor involvement as this will not be in the day to day operator's skill set. - Control system will need to split flows appropriately between different discharge locations, quantities of wastewater sent to different locations will also need to be considered.	- Power outages would affect pumping to scheme and irrigation system, but backup systems could control this - Irrigation infrastructure and pipeline is potentially at risk from third party damage - Crop failure is a risk, can be managed with effective operations - Permanent loss of market for crops is considered unlikely - Emerging/unknown contaminants present a potential risk to all disposal schemes, but are likely to be manageable with changes to treatment practices (if required) - Irrigation blocks can be rotated which provides inherent resilience to partial breakdowns across the irrigation scheme - Greater redundancy in the system with two river discharge locations and land disposal scheme - Some treatment would be possible without power due to the large area of the ponds but, if this condition occurs over a long period overloading will cause foul odours to be generated	3.0
		2	5	3	3	2	4	

Option	Variant	Can be staged	Constructable & Operational within 5yrs	Allows for Resource recovery	Can be Up-scaled	Operational / Technical Complexity	Operational Risk	Draft score
3: L+R (a) & (b)	Generic for both sub-options	- Conveyance infrastructure staging would require dual mains (an additional cost) and staggered pump installation - Revised discharge parameters to meet legislative requirements may require additional treatment processes - Irrigation infrastructure can be staged	- Expect Local contractors to have the experience to construct required infrastructure. - Land purchasing is achievable within this time frame - Design of the required infrastructure is achievable in this timeframe - There is an extent which the option influences time frame but all are predicted to be achievable	- Retaining digestors could allow for energy recovery through biogas with carbon additions - Nutrient resources within the wastewater stream are being actively recovered in agricultural product. - To achieve equivalent production on the same land, the re-use of the wastewater stream inherently means that freshwater resources are being spared e.g. promotes freshwater allocation to be used elsewhere within the region.	- Will need significant additional upgrades for hydraulic capacity through the plant - Inlet works may be a hydraulic constraint - This option is already a large land area however, so there may be limitations on acquiring suitable land. - Irrigation system can be expanded. There may be 're-work' required during scaling up the distribution infrastructure if this has not accounted for in the initial design.	- Scheme is relatively simple, although on a large scale - Odour/drift etc to be managed by buffer zones, application methods and management of storage systems - Irrigation schemes are generally considered high complexity to operate however, this would be the largest in New Zealand by wide margin, which is likely to increase operational complexity. - Crop/ forestry harvesting will require contractor involvement as this will not be in the day to day operators skill set. -Increased complexity with flow split - Greater redundancy in the system with dual scheme - No alum dosing required - Flow discharge to river based on high river flow rate	- Crop failure is a risk, can be managed with effective operations - Permanent loss of market for crops is considered unlikely - Emerging/unknown contaminants present a potential risk to all disposal schemes, but are likely to be manageable with changes to treatment practices (if required) - Irrigation infrastructure and pipeline is potentially at risk from third party damage - Land area basis will allow full discharge year-round - Power outages would affect pumping to scheme and irrigation system, but backup systems could control this	
	97 % applied to an inland land application site and a discharge to river in exceptional circumstance	- Treatment components cannot be staged		- Option intent is to support a commercial cut and carry crops complementary with discharge	- Aerated lagoons have a limited organic loading capacity and this will limit the total capacity of the process.	-Lagoon process will allow some treatment without power	- Some treatment would be possible without power due to the large area of the ponds but, but if this condition occurs over a long period overloading will cause foul odours to be generated - Organic overloading could cause odour issues	3.0
		3	5	4	2	3	2	

Option	Variant	Can be staged	Constructable & Operational within 5yrs	Allows for Resource recovery	Can be Up-scaled	Operational / Technical Complexity	Operational Risk	Draft score
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	- Installation of the second clarifier has the potential to be staged, this will be dependent on attributes of the influent and growth patterns. It also adds additional risk with reduced redundancy of the system		- Option intent is to grow a commercial forestry block complementary with discharge - With additional tertiary treatment a portion of the treated wastewater could be reused as a non-potable water supply - Potential to recover struvite which would reduce but not eliminate alum dosing requirement. This requires a 5-stage process so additional infrastructure. - Could be part of ETS / a carbon sink, so a positive from a sustainability / carbon offset perspective	- Additional treatment train capacity (PST, bioreactor and clarifier) could be installed to augment process	- Power required to supply aeration	- Full aeration to be supplied via mechanical aeration. - Risk of operational shutdowns due to forestry maintenance needs, but impacts can be limited by strategic design and management of forestry and infrastructure.	3.0
		3	5	5	2	2	2	
4: L + R (d) & (e)	Generic for both sub-options	- Conveyance infrastructure staging would require dual mains (an additional cost) and staggered pump installation - Revised discharge parameters to meet legislative requirements may require additional treatment processes - Irrigation infrastructure can be staged	- Expect Local contractors to have the experience to construct required infrastructure. - Land purchasing is achievable within this time frame - Design of the required infrastructure is achievable in this timeframe - There is an extent which the option influences timeframe but all are predicted to be achievable	- Retaining digestors could allow for energy recovery through biogas with carbon additions - Nutrient resources within the wastewater stream are being actively recovered in agricultural product. - To achieve equivalent production on the same land, the re-use of the wastewater stream inherently means that freshwater resources are being spared e.g. promotes freshwater allocation to be used elsewhere within the region.	- Will need significant additional upgrades for hydraulic capacity through the plant - Additional flow will reduce capacity of wet weather storage in converted lagoons - This option is already a large land area however, so there may be limitations on acquiring suitable land. - Irrigation system can be expanded. There may be 're-work' required during scaling up the distribution infrastructure if this has not accounted for in the initial design.	- Scheme is relatively simple, although on a large scale - Odour/drift etc to be managed by buffer zones, application methods and management of storage systems - Irrigation schemes are generally considered high complexity to operate however, this would be the largest in New Zealand by wide margin, which is likely to increase operational complexity. - Crop/forestry harvesting will require contractor involvement as this will not be in the day to day operators skill set -Increased complexity with flow split - Greater redundancy in the system with dual scheme - River flow triggers and recording of flow and load to river and to land required	- Irrigation infrastructure and pipeline is potentially at risk from third party damage - Crop failure/contamination are only a risk if scheme is inappropriately managed - Permanent loss of market for crops is considered unlikely - Emerging/unknown contaminants present a potential risk to all disposal schemes, but are likely to be manageable with changes to treatment practices (if required) - Prolonged low river flows could see infrequent flow to river. - Power outages would affect pumping to scheme and irrigation system, but backup systems could control this	3.0
	45 % applied to an inland land application site and			- Option intent is to support a commercial cut and carry crops complementary with discharge	- Aerated lagoons have a limited organic loading	- Lagoon process will allow some treatment without power		3.0

Option	Variant	Can be staged	Constructable & Operational within 5yrs	Allows for Resource recovery	Can be Up-scaled	Operational / Technical Complexity	Operational Risk	Draft score
	a river discharge for the remainder of the time				capacity and this will limit the total capacity of the process.			
		2	5	4	2	3	3	
	55 % applied to an inland land application site and a river discharge for the remainder of the time			- Option intent is to support a commercial cut and carry crops complementary with discharge	- Aerated lagoons have a limited organic loading capacity and this will limit the total capacity of the process.	- Lagoon process will allow some treatment without power		3.0
		2	5	4	2	3	3	
	Coastal land application site, with more land application 55% applied to a coastal land application site and a river discharge for the remainder of the time			- Option intent is to grow a commercial forestry block complementary with discharge - Would be part of ETS / a carbon sink, so a positive from a sustainability / carbon offset perspective. - With additional tertiary treatment a portion of the treated wastewater could be reused as a non-potable water supply	-additional treatment train capacity (PST, bioreactor and clarifier) could be installed to augment process	- Power required to supply aeration	- Risk of operational shutdowns due to forestry maintenance needs, but impacts can be limited by strategic design and management of forestry and infrastructure - Higher quality of treatment process	3.0
		2	5	5	2	2	2	
	55% applied to coastal land application site and a river discharge for the remainder of the time.			- Option intent is to grow a commercial forestry block complementary with discharge - Would be part of ETS / a carbon sink, so a positive from a sustainability / carbon offset perspective. - With additional tertiary treatment a portion of the treated wastewater could be reused as a non-potable water supply	-additional treatment train capacity (PST, bioreactor and clarifier) could be installed to augment process	- Power required to supply aeration	- Risk of operational shutdowns due to forestry maintenance needs, but impacts can be limited by strategic design and management of forestry and infrastructure - Higher quality of treatment process	3.0
		2	5	5	2	2	2	
6: Ocean	Generic for both sub-options	- Conveyance infrastructure staging would require dual mains (an additional cost) and staggered pump installation - Outfall could not be staged - Revised discharge parameters to meet legislative requirements may	- Expect Local contractors to have the experience to construct required infrastructure. - Land purchasing is achievable within this time frame	- Retaining digestors could allow for energy recovery through biogas with carbon additions	- Additional treatment train capacity (PST, bioreactor and clarifier) could be installed to augment process - Will need significant additional upgrades for hydraulic capacity through the plant	- Outfall will need periodic inspections and some maintenance of the diffuser over the long term - Reliant on pumping to scheme - Scheme is relatively simple, although on a large scale	- At risk of power failure but within WWTP site for operational repair - Pipeline is potentially at risk from third party damage - Power outages would affect pumping to scheme, but backup systems could control this	

Option	Variant	Can be staged	Constructable & Operational within 5yrs	Allows for Resource recovery	Can be Up-scaled	Operational / Technical Complexity	Operational Risk	Draft score
		require additional treatment processes	- Design of the required infrastructure is achievable in this timeframe - There is an extent which the option influences timeframe but all are predicted to be achievable		- Pipelines may have to be duplicated/upsized with additional pumping		- Emerging/unknown contaminants present a potential risk to all disposal schemes, but are likely to be manageable with changes to treatment practices (if required)	
	Ocean discharge, with a small % to land	- Irrigation infrastructure can be staged		- Nutrient resources within the wastewater stream are being actively recovered in agricultural product. - To achieve equivalent production on the same land, the re-use of the wastewater stream inherently means that freshwater resources are being spared e.g. promotes freshwater allocation to be used elsewhere within the region. - Option intent is to grow a commercial forestry block complementary with discharge - Would be part of ETS / a carbon sink, so a positive from a sustainability / carbon offset perspective. - Will be at a much smaller scale than Option 3 & 4 variants, therefore lesser potential for resource recovery/beneficial re-use	- Acquiring additional land area considered to be (comparatively) easier than the larger options. - Irrigation system can be expanded. There may be 're-work' required during scaling up the distribution infrastructure if this has not accounted for in the initial design.	- Increased complexity with flow split - Greater redundancy in the system with dual scheme - Odour/drift etc to be managed by buffer zones, application methods and management of storage systems - This option is the second smallest irrigation scheme within the BPO, so (comparatively) is considered the simpler to operate. - Forestry harvesting will require contractor involvement as this will not be in the day to day operators skill set.	- Risk of operational shutdowns due to forestry maintenance needs, but impacts can be limited by strategic design and management of forestry and infrastructure - Lesser risk due to the smaller area - Irrigation infrastructure is potentially at risk from third party damage - Crop failure/contamination are only a risk if scheme is inappropriately managed - Permanent loss of market for crops is considered unlikely	2.5
		1	5	3	1	3	2	
	Ocean discharge			- No land resource recovery available	- Ocean outfall may have to be duplicated, or bigger pumps added, depending on additional capacity built in when constructed			2.5
		1	5	2	1	3	2	

Note: Option 5, which involved a mix of groundwater discharge and land application, was removed from the short list during the short list development phase of the project.

1.6 Summary Assessment

The table below summarises the assessment scores for the technology and infrastructure comparative assessment.

Option	Variant	Can Be Staged	Constructable & Operational within 5yrs	Allows for Resource recovery	Can be Up-scaled	Operational / Technical Complexity	Operational Risk	Draft score
1: R2(b)	River discharge with enhanced treatment	4	5	3	4	3	4	4.0
	River discharge with enhanced treatment, and a small % to land	4	5	4	4	2	4	4.0
2: Dual R + L	Two river discharge points and a small % to land	2	5	3	3	2	4	3.0
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	3	5	4	2	3	2	3.0
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	3	5	5	2	2	2	3.0
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	2	5	4	2	3	3	3.0
	55 % applied to an inland land application site and a river discharge for the remainder of the time	2	5	4	2	3	3	3.0
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	2	5	5	2	2	2	3.0
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	2	5	5	2	2	2	3.0
6: Ocean	Ocean discharge, with a small % to land	1	5	3	1	3	2	2.5
	Ocean discharge	1	5	2	1	3	2	2.5

1 Natural Environment Comparative Assessment of Short-listed options

1.1 Introduction

This report sets out the Natural Environment comparative assessment of the short-listed options for the Palmerston North Wastewater BPO project ("Nature Calls").

The report was prepared by:

- Keith Hamill assessed effects on freshwater environments. Keith is a director and Principal Environmental Scientist with River Lake Ltd. Keith has 24 years' experience in environmental management and ecological assessments on freshwater environments. He has been involved in assessing the effects of the Tōtara Road WWTP on the Manawatū River since 2011.
- Dr Olivier Ausseil assessed effect on freshwater environments. Oliver is a director and Principal Scientist with Aquanet Consulting Ltd with over 18 years professional experience in New Zealand. Olivier has been involved as a technical advisor on behalf of consenting authorities, applicants and submitters on over 35 resource consent applications for discharges of treated domestic wastewater to land and/or water, from both medium-sized towns and small communities. He developed the initial versions of Aquanet's PointSim model for the Feilding WWTP re-consenting process. Olivier has been involved in involved in assessing the effects of the Tōtara Road WWTP on the Manawatū River since 2017, with a particular focus on monitoring and modelling the effects of the discharge on the Manawatū River's water quality and ecology.
- Aslan Perwick assessed effects on soils and groundwater. Aslan is a lead Groundwater Scientist with Pattle Delamore Partners Ltd with over 13 years' experience. Aslan specialises in assessing groundwater effects from discharges to land, and has been involved in several municipal discharge to land consent applications/studies, acting for applicants and as an expert reviewer. Some notable previous municipal projects Aslan has been involved in are: Watercare WWTP discharge applications (Omaha-Matakana WWTP, Wellsford WWTP, Warkwork-Snells WWTP, Army Bay WWTP, Waiuku-SW WWTP), Featherstone WWTP, Cooks Beach WWTP, Te Anau WWTP, and Waipu WWTP.
- David Cameron assessed effect on the Coastal Environment. David is a Principle Environmental Scientist with Stantec Ltd with over 30 years' experience in water quality and aquatic ecology assessment. He was involved in the preparation Tōtara Road WWTP consent application in 2001 and has assessed the effects of coastal outfall discharges at Pencarrow, Moa Point, Karori, Porirua, Hastings, Tauranga and Ruakaka.

1.2 Criterion and scoring approach

The comparative assessment for effects on the Natural Environment assessed the potential adverse environmental effects of each option on the receiving environments, particularly in relation to water quality (including the matters listed in s107 (1) (c) to (g)), soils, and aquatic ecology. It was assumed that all options would be implemented and managed so as to have little effect on terrestrial ecology.

The different options were assessed for effects on the Natural Environment using a scale of 1 to 5 with a low score of 1 reflecting a poor outcome and a high score of 5 reflecting a good outcome. Criteria used to determine each score are described in **Table 1**.

Separate assessments were made for potential effects on “Freshwater Systems” (including the Manawatū River and small local streams and lakes potentially affected by the land irrigation), Groundwater and Soils, and the Coastal Environment (including the estuary, beaches and ocean floor). The lowest score for any sub-group was used to determine the overall score for the group. For example, separate scores were given to potential effects on the Manawatū River and small streams or lakes near the irrigation area, and the lowest score determined the combined score for ‘Rivers’. Similarly, separate scores were assigned to Groundwater and Soils, and the lowest score determined the combined score for ‘Groundwater and Soils’.

The Overall Score for the Natural Environment was the lowest score (i.e. worst score) assigned for “Rivers”, “Groundwater and Soil”, and the “Coast”. However, to help with differentiating between different options we have also shown the average score from each of these categories.

Table 1: Criteria used to score Natural Environment components of "Rivers", "Groundwater and Soil", and the "Coast".

Score	traffic light	Description	Freshwater (rivers and lakes)	Coastal
1	Red: Very High adverse effects	Major loss or alteration of baseline conditions (in absence of current discharge)	a) Effects on water quality and/or aquatic ecology of the Manawatu River (including the estuary) are overall similar than currently; b) The option causes 'high' or 'very high' adverse effects on other freshwater environments; c) The One Plan targets for periphyton cover or biomass are likely to be regularly exceeded (i.e. more than 8% of samples); d) The One Plan target relative to QMCI change (20% reduction) is likely to be regularly exceeded; e) Ammonia poses a risk of chronic or acute toxic effect to a range of species (specifically in excess of the 95% species protection level, i.e. the protection level set in the One Plan).	a)The effects on water quality and/or aquatic ecology in the Seawater Management Zone after reasonable mixing represent a major loss or alteration from baseline condition; b) The effects on marine benthic ecology outside of a zone of reasonable mixing are significant; c) The One Plan target for algal biomass is likely to be regulary exceeded; d) Ammonia poses a risk of chronic or acute toxic effect to sensitive species (specifically in excess of the 99% protection level for ammoniacal nitrogen, i.e., the protection level set in the One Plan).
2	Orange: High adverse effects	Major alteration of baseline conditions (in absence of current discharge)		
3	Yellow: Moderate adverse effects	Alteration to existing baseline conditions. Generally effects are moderate but acceptable in the context of magnitude, spatial scale, duration and frequency.	a) The effects on the Manawatu River represent a substantial improvement compared with the current situation; b) The effects on water quality and ecology are measurable but generally meet One Plan targets; c) There is a moderate risk of (i.e. of short duration and/or infrequent) exceedance of the One Plan targets.	a)The effects on water quality and/or aquatic ecology in the Seawater Management Zone after reasonable mixing represent a slight to moderate deterioration compared with the baseline conditions; b)The effects on marine benthic ecology outside of a zone of reasonable mixing zone are measurable but not significantly adverse; c)There is a moderate risk of exceedance of the One Plan targets.
4	Green: Low adverse effects	Minor shift from baseline conditions or ecological populations (in absence of current discharge).		
5	Blue: Very Low adverse effects	Very slight change in baseline conditions.	a) The effects on the Manawatu River represent a substantial reduction/improvement compared with the current situation; b) The effects on water quality and ecology are likely to be small and of short duration/infrequent so as to have negligible overall ecological effect. c) The risk of exceedances of the One Plan targets is very low.	a)The effects on water quality and ecology in the Seawater Management Zone are unlikely to be measurable; b)The risk of exceedances of the One Plan targets is very low.

Score	traffic light	Description	Groundwater	Soils
1	Red: Very High adverse effects	Major loss or alteration of baseline conditions (in absence of current discharge)	a) Likely to cause greater than minor adverse effects on groundwater quality within the regional GW resource e.g. significantly degraded from current status; b) The option is likely to cause 'high' or 'very high' adverse effects on other receiving/connected freshwater environments (water quality and/or water quantity/flow) ; c) Likley to cause adverse effects/consume >1% of the presently available groundwater quantity (regional aquifer) d) Likely to cause adverse groundwater mounding effects (off site) e) Overall greater than minor adverse effects expeced. Nill positive effects expected.	a) Likely to cause adverse effects on soil chemical properties, e.g. acidicifation b) Likely to cause irreparable change or detrimental damage to the soil physical properties, e.g. erosion, compaction, loss of cohesion c) Very high risk of accumulation of heavy metals and soil contaminants including micronutrients, d) Likely to result in a detrimental effect on the soil biological properties and soil fertility as such that the soil becomes desolated. e.g. crop growth rate reductions
2	Orange: High adverse effects	Major alteration of baseline conditions (in absence of current discharge)		
3	Yellow: Moderate adverse effects	Alteration to existing baseline conditions. Generally effects are moderate but acceptable in the context of magnitude, spatial scale, duration and frequency.	a) Unlikely to cause more than minor adverse effects on groundwater quality within the regional GW resource e.g. less than minor degradation from current status; b) The option is likely to cause less than minor adverse effects on other receiving/connected freshwater environments (water quality and/or water quantity/flow) ; c) Likely to have a neutral or less than minor effect on the presently available groundwater quantity (regional aquifer) d) Unlikely to cause more than minor adverse groundwater mounding effects (off site) e) Overall minimal-minor adverse effects on groundwater expected. Minimal positive effects expected.	a) Unlikely to cause more than minor adverse effects on the soil physical, chemical or biological properties e.g. relative to other anthropogenic activities in the region, including urban and agricultural land use. b) Low risk of heavy metals/micronutrients issues in the soil insofar that standard soil management practices are not considered able to keep these to less than minor effects.
4	Green: Low adverse effects	Minor shift from baseline conditions or ecological populations (in absence of current discharge).		
5	Blue: Very Low adverse effects	Very slight change in baseline conditions.	a) Likely to result in groundwater quality benefits within the regional GW resource e.g. significantly improvment from current status; b) The option is likely to significantly improve either the water quality and/or water quantity (flow) of receiving/connected freshwater environments; c) Likely to cause positive effects/increase the presently available groundwater quantity (regional aquifer) d) Unlikely to cause any discernable groundwater mounding effects (off site) e) Overall negliible/minimal adverse effects on groundwater expected. Some positive effects expected.	a) Likely to lead to beneficial changes in physico-chemical and biological properties of the soil b) Increase in soil microorganisms metabolic activities c) Unlikely to cause any net long term adverse effect on the soil physical, chemical or biological properties d) Imporves soil stability / reduces soil erosion

1.3 Approach to the assessment

The effects assessment considered the magnitude, spatial scale, duration, frequency of effects and certainty in predictions. Comparisons were in the context of expected background conditions in the absence of the current discharge. By way of reference, the effects of the current discharge on the Manawatū River were considered to be unacceptable due to the excessive periphyton growth and corresponding effects of aquatic macroinvertebrate communities during periods of low flow.

Some options had higher levels of uncertainty about whether they would consistently be within acceptable levels (e.g. Option R2b). In these situations, lower scores were given to options that allowed little opportunity for practicing adaptive management by expanding the treatment system in some way; this is particularly relevant to option R2b. Similarly, for some land treatment options there was some uncertainty about the degree of effects on small streams or lakes near the irrigation areas, so better scores were given to options that had more opportunity to avoid catchments of sensitive waterbodies due to smaller land area requirements.

1.4 Assumptions applied in the assessment

1.4.1 Freshwater

Discharges to the Manawatū River increase the concentration of nutrients in the river which can stimulate excessive periphyton growth. This in turn reduces the health of aquatic macroinvertebrate communities in the river, effects the dissolved oxygen regime and has potential effects on fish. Key considerations in assessing potential effects on the Manawatū River were the effects on achieve One Plan targets for periphyton (biomass/cover) and nutrient concentrations. Restricting discharges to higher flows (greater than about median flow) dramatically reduces the potential for periphyton to grow. Similarly shifting the discharge location to downstream of Opiki reduces ecological effects because habitat starts to constrain periphyton growth downstream of this location. Restricting discharges to higher flows is generally not as effective at reducing annual nutrient loads discharged to the coast as options with N and P treatment for a wide range of flows.

The focus of the assessment on the Manawatū River was on minimising the effects of eutrophication currently observed in the River. Thus, a strong emphasis was given to the effects of nitrogen (N) and phosphorus (P) in the discharge. A Water Quality and Periphyton Model has been developed to better understand effects on the river and how different options would impact on the river achieving targets set in the One Plan. The assessment relied on the results of this model (called the Point Source Impact Model (PointSIM) is described in Greer and Ausseil (2019, 2020a, 2020b), in addition to monitoring data and investigations assessing the effects of the current discharge.

The spraying of effluent has potential effects on small waterways and lakes close to the irrigation area from the leaching of nitrate into the groundwater. The extent of this risk was assessed by considering the N leaching rate the irrigation compared to likely rates from current landuse, likely proximity of waterbodies, buffer zones, the potential to avoid streams in the irrigation area, seasonality in application and the potential benefits from increase flow volumes. This relied on information in the groundwater assessment and location of potential irrigation sites (PDP 2020b, Appendix B).

The scenario with the worse score for waterways near irrigation area were Options L+R(e) (score 3). This score was given because the irrigation area, assumed for this option for the purposes of this assessment, is anticipated to include substantial areas of some small lake catchments and there is uncertainty on the effect of N on the lake. This score would improve to 4 if the effluent was first treated for and so allow a smaller irrigation area that avoided the lake catchments. The scenario with land treatment that has the best score for small waterbodies is O-1 (scored 5). Negligible effects were expected for this scenario because the land discharge area was small so easy to avoid sensitive areas, the discharge is limited to summer when N uptake is highest, and the N leaching rate was small (10 kg N/ha/ya).

The risk of direct effects of the irrigation on local streams is very low because a 200m buffer zone will be used. The risk of P leaching is very low because the soils in the irrigation areas are P deficient and have a large P sorption capacity.

The potential effects of emerging contaminants on the environment was considered to be equal for all treatment options for the purpose of this process. The weighting of effects will largely depend on the values placed different receiving environments (i.e. land, river or coast). In general land treatment will provide better options for removal of emerging contaminants but may bring with it the risk of land contamination. Overall, there too many unknowns to use the potential risks posed by emerging contaminants in the assessment.

1.4.2 Coastal

In assessing the effects of the different options on coastal sites attention was given to the extent to which they would contribute to nitrogen loads in sensitive coastal areas (e.g. in estuaries and near-shore), effect on One Plan targets for coastal areas, and direct effects of the discharge on benthic habitat associated with the outfall.

Information on the treatment of nitrogen loads was from PDP (2020b, Table 3) and from estimated nitrogen removal from N treatment options using the PointSIM model.

1.4.3 Groundwater and Soils

The description of land treatment options including assumed leaching rates and removal rates and key assumptions is described in PDP (2020a, 2020b)

Groundwater is potentially influenced by nitrogen leaching from land application of effluent. The risk reduces when managing application to have low nitrogen leaching rates and low leaching rates relative to current landuse. The risk is also reduced when the land application is seasonal during dryer periods. The risks can increase when land application is in sensitive catchments (e.g. coastal lakes) or if the availability of suitable land threatens to limit ability to apply required buffer zones.

Key Risks relating to soils considered in the assessment were:

- Potential for areas of compacted soil structure from mechanical harvest of the cut & carry crop, particularly when soils are at or above field capacity. Risk is reduced by the reduced period of wastewater application, relative to the year round discharge options
- Potential mining of soil nutrients from insufficient nutrient loads relative to the export of nutrients in crops, depleting the soil nutrient pool reserves and reducing soil fertility, if wastewater is the only nutrient supply - risk reduced by addition of soil fertiliser/applications.
- Potential for acidification of the soil profile, resulting in release of cations and a reduction in soil microbial activity
- Some heavy metal accumulation likely to occur slowly over long periods of time e.g. but can be managed by phytoremediation and other soil treatment measures

1.5 Assessment table

The following table sets out the preliminary assessment of the options by the authors. This will be used as a starting point for discussion at the MCA workshop. The final MCA assessment and score may therefore differ from what is set out below.

Table 2: Summary of overall assessment for Rivers, Coast and Groundwater and Soils.

Option	Variant	Assessment	FW	Coast	GW / soils	Overall score
1: R2(b)	River discharge with enhanced treatment	Manawatū River close to targets and limited options for adaptive management.	3	5	5	3
	River discharge with enhanced treatment + 75% DWF to land	Manawatū River likely to achieve targets but risk in dry years and uncertainty in modelling. Opportunity for adaptive management.	3.5	5	5	3.5
2: Dual R + L (b)	Two river discharge points (Tōtara Rd and Opiki) 75% ADWF to land during low flows.	Manawatū River has small ecological effects but load reduction less than other options.	4	4.5	4.5	4
3: L+R (a) & (b)	97% to land at inland sites *	Groundwater risk from large land area with year round irrigation.	4	5	3.5	3.5
	97% to land at coastal sites *	Small waterways near irrigation and groundwater risk.	4	4.5	4	4
4: L + R (d) & (e)	Land application to inland sites when river <80 m^3/s	Manawatū River discharge occurs at river flows above median.	4	4.5	4.5	4
	Land application to inland sites when river <62 m^3/s	Manawatū River discharge occurs at river flows below median	4	4.5	4.5	4
	Land application to coastal sites when river <80 m^3/s	Risk to small waterbodies near irrigation area due to the large land area extending into lake catchments.	3	4	4	3
	Land application to coastal sites when river <62 m^3/s	Risk to small waterbodies near irrigation area due to the large land area extending into lake catchments.	3	4	4	3
6: Ocean	Ocean * with 50% ADWF applied to land during summer	Coastal zone	5	4.5	5	4.5
	Ocean *	Coastal zone	5	4	5	4

Note: Option 5, which involved a mix of groundwater discharge and land application, was removed from the short list during the short list development phase of the project.

* = Highest 3% of wastewater flows will still discharge to the Manawatū River at Tōtara Road.

Table 3: Scores and reasons for Freshwater Manawatu River and waterways near irrigation area.

No.	Option	Rivers	Manawatū	Waterways near irrigation		
		Score	Score	Score	Summary	Reason
1	R2b	3	3	5	Much better than current. Generally meets OP periphyton targets but possible occasional exceedance of OP periphyton targets. Little opportunity for adaptive management if exceedances occur.	Excessive periphyton growth (as in exceeding the nominal OP target for biomass and/or cover) will be substantially reduced in terms of their frequency, severity and spatial extent. However, risk that One Plan target may not be met (at 8% exceedance tolerance), especially at current monitoring site due to limited mixing. Key risk period remains long periods of low river flows especially in summer/early autumn. SIN and DRP concentrations at river flows< 20th FEP reduced by 92% and 50% respectively. Key uncertainties/risks: (1) periphyton modelling has high uncertainty. Cannot confirm if the OP periphyton target will be fully met and this would need carefully monitoring. Conversely the model likely over-estimates periphyton biomass as N and P get closer to upstream concentrations. (2) Wastewater treatment as proposed is understood to be at or near technological limit, with limited options to improve treatment further if in-river periphyton targets are not fully met. Adaptive management options are limited to: (1) improve mixing and/or increase length of the zone of reasonable mixing, (2) discharge all or part of the wastewater to land during low river flows (see option R2b(2)). Score would be lower if assuming no N removal in wetland.

No.	Option	Rivers	Manawatū	Waterways near irrigation		
1	R2b 2	3.5	3.5	5	A material improvement over R2b 1a with a higher certainty of meeting OP targets due to partial removal of the discharge during low river flows. But some occasional exceedances of OP periphyton target may still occur, e.g. during dry years. Ability for adaptive management by future expansion of land application if monitoring shows this is needed. Not as good for Manawatu as L+R (d) or (e). Very low risk of effects on local streams within irrigation area, as irrigation will only occur during dry season.	98% reduction in SIN and 40% reduction in DRP compared to current discharge. Full removal from river at low flows will avoid vast majority of periphyton issues. P managed at intermediate flow to control shoulder season periphyton. But some occasional exceedances of OP periphyton target may still occur and remaining uncertainty re. overall compliance with OP target (at 8% tolerance) during dry years. More resilient than R2b1 with ability for adaptive management to increase the % discharge to land if needed. This gives more comfort that periphyton effects can be managed within limits. Low risk of effects on local streams within irrigation area, as irrigation will only occur during dry season (high nutrient retention/low losses are expected). Also large buffers and N loading rates less than moderately intensive dairy so a possible in improvement in N in local streams concentrations.
2	Dual R + L (b)	4	4	5	Negligible effect at Tōtara Road. Negligible to small effects in Manawatu d/s Oroua. Adaptive management possible with land treatment component. Moderate improvement in N load. Low risk to local streams. N loading of 20kg N/ha/yr likely similar to current landuse. Discharge during summer low flow reduces risk of irrigation to any local waterways. Soils are P deficient so very little P loss.	Little impact at Totara Road as high periphyton biomass very rare at >62 m3/s. Little periphyton effect at d/s Opiki site due to habitat constraints. ca. 50% less SIN compared to current. Future resilience with ability to extend either treatment or land.

No.	Option	Rivers	Manawatū	Waterways near irrigation		
3	L+R (a)	4	5	4	Negligible effect on Manawatu River. Low risk to local waterways but irrigation is year round so high risk compared to option with a summer only discharge.	Negligible river effect on Manawatū River. Small risk to nearby waterways managed by buffers, leaching rate (21kg N/ha/yr) similar or better than current landuse and options to mitigate effects on local waterways with riparian planting/shading. Negligible P leaching. Potential benefits by increasing baseflow.
3	L+R (b)	4	5	4	Negligible effect on Manawatu River. Low risk to coastal streams and lakes due to buffers zones, mostly avoiding lake catchments and low leaching rate of 15 kg/ha/yr. Risk of limited land availability to apply the buffers.	Small risk to nearby waterways managed by buffers, mostly avoiding lake catchments, and low leaching rate (15 kg N/ha/yr) . Negligible P leaching. Irrigation mostly avoids lake catchments, avoids upgradient of all lakes and applies a min. 200m buffer. Score assumes local stream mitigation and N within NPS-FM. Potential to mitigate effects on local waterways with riparian planting/shading. Potential benefits by increasing baseflow.
4	L + R (d) 1	4	4	4.5	Only small effect on Manawatū River. A little more risk to the river than L+R(d)2 but room for adaptive management. Risk to local streams is low (little winter irrigation and low leaching rate).	Low risk of effects on periphyton in Manawatu at Totara Rd with discharges >62m3/s. Significant reduction in PNCC's contribution to in-river loads/concentrations. Very little more risk to Manawatu than L+R (d)2. Periphyton risk slightly higher than L+R(d)2 but not enough to justify different grading.
4	L + R (d) 2	4	4	4.5	Only small effect on Manawatū River with high flow discharges. Risk to local streams is low (little winter irrigation and low leaching rate).	Manawatū River periphyton risk slightly lower than Option L+R(d)1, but not enough to justify different grading. Risk to local streams is similar to L+R (a) but less winter irrigation and lower leaching rate (15 kg N/ha/yr) so reduced risk.

No.	Option	Rivers	Manawatū	Waterways near irrigation		
4	L + R (e) 1	3	4	3	Only small effect on Manawatū River. Moderate risk and uncertainty of effects on coastal streams and lakes due to large land area extending into lake catchments.	Low risk to Manawatū River periphyton as described in L&R(d)1. Land treatment area extends into the catchment of some coastal lakes. See discussion for L+R(e)2.
4	L + R (e) 2	3	4	3	Only small effect on Manawatū River with high flow discharges. Moderate risk and uncertainty of effects on coastal streams and lakes due to large land area extending into lake catchments.	Low risk to Manawatu River periphyton as described in L+R(d)2. Land treatment area is very large because no treatment for N, and extends over some lake catchments. Higher N leaching rate (20 kg N/ha/yr) than likely current landuse. Effect on local streams will depend on current state. Score will improve to 4 if treating N at source to 25 mg N/L.
	Ocean					
6	O -1	5	5	5	Negligible effect on Manawatu River. Negligible effect on local streams due to small land discharge, during summer and low N leaching rates.	No discharge to Manawatū River except at flood flows. Negligible effect on local streams due to small land discharge during summer (when high nutrient retention). Small N leaching rate of 10 kg/ha/yr. The small land area for irrigation allows options to avoid sensitive areas.
6	O -2	5	5	5	Negligible effect on freshwater systems or estuary.	No discharge to Manawatū River except at flood flows.

Table 4: Scores and reasons for the coastal environment.

No.	Option	Coastal	
		Score	**Reason**
1	R2b	5	Negligible increases in N and P concentrations in coastal water in the vicinity of the Manawatu River mouth. Note a 95% reduction in N load to coast compared to current discharge.
1	R2b 2	5	Negligible increases in N and P concentrations in coastal water in the vicinity of the Manawatu River mouth. Slightly improved over R2b but enough to change score.
2	Dual R + L (b)	4.5	Slight local increases in N and P concentrations in coastal water in the vicinity of the Manawatu River mouth. N load to coast a little less (about 15%) than current.
3	L+R (a)	5	Negligible effect on coastal waters
3	L+R (b)	4.5	Slight local increases in N concentrations in nearshore coastal water adjacent to land application sites (estimated 23,000 kg nitrogen leached per year) is possible. Negligible P.
4	L + R (d) 1	4.5	Slight local increases in N and P concentrations in coastal water in the vicinity of the Manawatū River mouth.
4	L + R (d) 2	4.5	Slight local increases in N and P concentrations in coastal water in the vicinity of the Manawatū River mouth.
4	L + R (e) 1	4	Slight local increases in N and P concentrations in coastal water in the vicinity of the Manawatū River mouth and in nearshore waters adjacent to land application sites (estimated 12,000 kg nitrogen leached per year).
4	L + R (e) 2	4	Slight local increases in N and P concentrations in coastal water in the vicinity of the Manawatū River mouth, and in nearshore waters adjacent to land application sites (estimated 16,000 kg nitrogen leached per year).
	Ocean		
6	O -1	4.5	Slight local increases in N, P and POM in discharge plume close to outfall diffuser, and some potential for POM deposition on seabed. Local increase in nitrogen in nearshore coastal waters because of an estimated 12,000 kg N leached from land application area per year. Discharge 2km offshore has high dilution and is well separated from sensitive near-shore coastal environments.
6	O -2	4	Slight to moderate local increases in N, P and POM in discharge plume close to outfall diffuser, and likely some POM deposition on seabed. Discharge 2km offshore has high dilution and is well separated from sensitive near-shore coastal environments.

Table 5: Scores and reasoning for Groundwater and Soil

No.	Option	GW & Soil	GW & Soil	Groundwater		Soil	
		Score	Summary	Score	Reason	Score	Reason
1	R2b	5	No effects on GW or soil.	5	No significant discharge to groundwater	5	No significant soil impacts
1	R2b 2	5	Negligible effects on GW. Very low leaching rate of 7.5 kg M/ha/yr, likely less than current. Small land area, seasonal irrigation. Negligible effects on soil.	5	Very low leaching rates of 7.5 kg N/ha/yr estimated, lower than other permissible landuses on this soil. Comparatively the smallest land area of all Land-based options. Seasonal irrigation only. Existing land-use is intensive agricultural (High Production Exotic Grassland), so likely to have higher N application and leaching rates 'Downstream' position within catchment, primary groundwater discharge into the Manawatu River. Land area includes possible wetland sites which are likely to be groundwater supported Likely to have negligible groundwater effects, and some water quality and quantity/flow benefits expected.	5	Overall negligible/minimal soil effects expected. Key Risks outlined below - but all considered manageable under standard practices: - Potential for areas of compacted soil structure from mechanical harvest of the cut & carry crop, particularly when soils are at or above field capacity. Risk is reduced by the reduced period of wastewater application, relative to the year round discharge options - Potential mining of soil nutrients from insufficient nutrient loads relative to the export of nutrients in crops, depleting the soil nutrient pool reserves and reducing soil fertility, if wastewater is the only nutrient supply - risk reduced by addition of soil fertiliser/applications. - Potential for acidification of the soil profile, resulting in release of cations and a reduction in soil microbial activity - some heavy metal accumulation likely to occur slowly over long periods of time e.g, but can be managed by photoremediation and other soil treatment measures

No.	Option	GW & Soil	GW & Soil		Groundwater		Soil
2	Dual R + L (b)	4.5	Small effects on GW. Leaching rate of 20 kg M/ha/yr similar to current landuse. Negligible effects on soil.	4.5	Leaching rates of 20 kg N/ha/yr estimated, and is comparable or lower than other permissible landuses on these soils Comparatively the small land area of all Land-based options. Seasonal irrigation only. Existing land-use is intensive agricultural (High Production Exotic Grassland), so likely to have higher N application and leaching rates 'Downstream' position within catchment, primary groundwater discharge into the Manawatu River. Land area includes possible wetland sites which are likely to be groundwater supported Likely to have negligible groundwater effects, and some water quality and quantity/flow benefits expected.	5	as above

No.	Option	GW & Soil	GW & Soil	Groundwater		Soil	
3	L+R (a)	3.5	Small to moderate effect on GW. Large land area for irrigation but leaching rates (20-27 kg N/ha/yr) likely similar or less than existing landuse. Year round application increases the risks. Small effect on soils but large land area being irrigated which increases risk.	3.5	Leaching rates of ~20-27 kg N/ha/yr estimated, and is comparable or lower than other permissible landuses on these soils Comparatively large land area of all Land-based options. Year-round irrigation requirement (less desirable). Existing land-use is intensive agricultural (High Production Exotic Grassland), so likely to have similar or potentially higher N application and leaching rates 'Downstream' position within catchment, primary groundwater discharge into the Manawatu River, but a number of stream/drains within the nominated area Land area includes possible wetland sites which are likely to be groundwater supported Likely to have less than minor adverse groundwater effects. Some water quantity/flow benefits expected (more so than the smaller LA options)	4	as above - but largest option and requires effectively year-round harvesting, so the overall risk is considered higher/more complex to manage

No.	Option	GW & Soil	GW & Soil		Groundwater		Soil
3	L+R (b)	4	Small effect on GW. Low leaching rate (15 kg N/ha/yr) but likely more than current landuse. Large land area but less than for L+R(a). Yearround application. Negligible to small effect on soils. Likely to stabilise soils but potential for small areas of compaction. Uptake of nutrients is less than cut and carry.	4	Generally low leaching rates of 15 kg N/ha/yr estimated, but generally greater than existing. Large land area required so total loading is high but less than for L+R(a) - due to addition N treatment at WWTP Year-round irrigation requirement (less desirable) Existing low-intensity or non-economic land-use. Mixture of mobile, dune systems, small proportion of exotic forestry, small proportion of agricultural. Vast majority of groundwater is likely to discharge into the marine environment. Set back will be required from dune lakes & freshwater bodies. Land area includes/borders wetland sites which are likely to be groundwater supported - but nature of these feature requires specific assessment e.g. perched or window? HRC suggests that existing groundwater quality may be nitrogen impacted. Requires confirmation. The option may provide groundwater quality improvements. Likely to have less than minor adverse groundwater effects. Some water quantity/flow benefits expected (more so than the smaller LA options).	4.5	Overall less than minimal soil effects, plus expected erosion reduction benefits (e.g. establish of forestry on presently easily erodible/movable soils) - Likely to stabilise soil structure on in areas on sandy dunes where erosion occurs - Potential for confined areas of compaction of soils occurring from tree maintenance and at harvest - but risks deemed manageable. - Uptake of nutrients per year is likely to be lower than cut and carry land uses, less ability to accumulate and remove heavy metals

No.	Option	GW & Soil	GW & Soil	Groundwater		Soil	
4	L + R (d) 1	4.5	Small effect on GW. Low leaching rate (15 kg N/ha/yr) similar to current landuse. Seasonal application reduces risks. Negligible to small effect on soils. Uptake of nutrients is less than cut and carry.	4.5	Leaching rates of 15 kg N/ha/yr estimated, and is comparable or lower than other permissible landuses on these soils Comparatively the moderate land area of all Land-based options. Seasonal irrigation (but more shoulder season requirement than R2b and Dual R+L). Existing land-use is intensive agricultural (High Production Exotic Grassland), so existing landuse is likely to have higher N application and leaching rates 'Downstream' position within catchment, primary groundwater discharge into the Manawatu River, but a number of stream/drains within the nominated area Land area includes possible wetland sites which are likely to be groundwater supported Likely to have less than minor adverse groundwater effects. Some water quality and quantity/flow benefits expected. Low leaching rates of 15 kg N/ha/yr estimated. Lower than current Horizons requirements Current land-use is agricultural so maybe higher application and leaching rates	4.5	as above for L+R(a) - but lesser area

No.	Option	GW & Soil	GW & Soil		Groundwater		Soil
4	L + R (d) 2	4.5	Small effect on GW. Low leaching rate (15 kg N/ha/yr) similar to current landuse. Seasonal application reduces risks. Negligible to small effect on soils. Uptake of nutrients is less than cut and carry.	4.5	Groundwater is likely to discharge into the Manawatu River Land area includes 2 possible wetland sites which are likely to be groundwater supported Current shallow groundwater quality is relatively good. At least two shallow bores immediately downstream that may be affected Effects are manageable Leaching rates of 15 kg N/ha/yr estimated, and is comparable or lower than other permissible landuses on these soils Comparatively the moderate land area of all Land-based options. Seasonal irrigation (but more shoulder season requirement than R2b and Dual R+L). Existing land-use is intensive agricultural (High Production Exotic Grassland), so existing landuse is likely to have higher N application and leaching rates 'Downstream' position within catchment, primary groundwater discharge into the Manawatu River, but a number of stream/drains within the nominated area Land area includes possible wetland sites which are likely to be groundwater supported Likely to have less than minor adverse groundwater effects. Some water	4.5	as above for L+R(a) - but lesser area

No.	Option	GW & Soil	GW & Soil		Groundwater		Soil
					quality and quantity/flow benefits expected. Low leaching rates of 15 kg N/ha/yr estimated Lower than current Horizons requirements Current land-use is agricultural so maybe higher application and leaching rates Groundwater is likely to discharge into the Manawatu River Land area includes 2 possible wetland sites which are likely to be groundwater supported Current shallow groundwater quality is relatively good. At least two shallow bores immediately downstream that may be affected. Effects are manageable		

No.	Option	GW & Soil	GW & Soil		Groundwater		Soil
4	L + R (e) 1	4	Large land area reaquired. Low leaching rates (20 kg N/ha/yr) but greater than current landuse. Seasonal irrigation reduces risks. Needs setback from dune lakes. Small effect on soils. Likely to stabilise soils but potential for small areas of compaction. Large land area.	4	Generally low leaching rates of 20 kg N/ha/yr estimated, but generally greater than existing. Under TN- 35 mg/L effluent - second largest coastal site land area. Seasonal irrigation (but more so than O+L). Existing low-intensity or non-economic land-use. Mixture of mobile, dune systems, small proportion of exotic forestry, small proportion of agricultural. Vast majority of groundwater is likely to discharge into the marine environment. Set back will be required from dune lakes & freshwater bodies. Careful management required. Land area includes/borders wetland sites which are likely to be groundwater supported - but nature of these feature requires specific assessment e.g. perched or window? HRC suggests that existing groundwater quality may be nitrogen impacted. Requires confirmation. The option may provide groundwater quality improvements. Likely to have less than minor adverse groundwater effects. Some water quantity/flow benefits expected (more so than the smaller LA options).	4.5	as above for L+R(b) - but greater area

No.	Option	GW & Soil	GW & Soil		Groundwater		Soil
4	L + R (e) 2	4	Large land area reaquired. Low leaching rates (20 kg N/ha/yr) but greater than current landuse. Seasonal irrigation reduces risks. Needs setback from dune lakes. Small effect on soils. Likely to stabilise soils but potential for small areas of compaction. Large land area.	4	Generally low leaching rates of 20 kg N/ha/yr estimated, but generally greater than existing. Under TN- 35 mg/L effluent - largest coastal site land area. Seasonal irrigation (but more so than O+L, and the 60 m3/s option). Existing low-intensity or non-economic land-use. Mixture of mobile, dune systems, small proportion of exotic forestry, small proportion of agricultural. Vast majority of groundwater is likely to discharge into the marine environment. Set back will be required from dune lakes & freshwater bodies. Careful management required. Land area includes/borders wetland sites which are likely to be groundwater supported - but nature of these feature requires specific assessment e.g. perched or window? HRC suggests that existing groundwater quality may be nitrogen impacted. Requires confirmation. The option may provide groundwater quality improvements. Likely to have less than minor adverse groundwater effects. Some water quantity/flow benefits expected (more so than the smaller LA options).	4.5	as above for L+R(b) - but greater area
	Ocean						

No.	Option	GW & Soil	GW & Soil		Groundwater		Soil
6	O -1	5	Negligible effect on GW due to small scale application, and low leaching rates (10 kg N/ha/yr). Negligible effect on soils due to small scale application.	5	Low leaching rates of 10 kg N/ha/yr estimated, but generally greater than existing. Under TN- 35 mg/L effluent - smallest coastal site land area. Seasonal irrigation (lowest land proportion of the coastal options). Existing low-intensity or non-economic land-use. Mixture of mobile, dune systems, small proportion of exotic forestry, small proportion of agricultural. Vast majority of groundwater is likely to discharge into the marine environment. Set back will be required from dune lakes & freshwater bodies. Careful management required. Land area includes/borders wetland sites which are likely to be groundwater supported - but nature of these feature requires specific assessment e.g. perched or window? HRC suggests that existing groundwater quality may be nitrogen impacted. Requires confirmation. The option may provide groundwater quality improvements. Likely to have less than negligible/minimal adverse groundwater effects. Likely to have minimal negative effects.	5	as above for L+R(b) - but smallest scale

No.	Option	GW & Soil	GW & Soil	Groundwater		Soil	
6	O -2	5	No discharge to GW or soils.	5	No discharge to groundwater	5	No soil impacts

Appendix 1: Additional information used in the assessments

Wastewater quality used in assessing the option O-2 (all to ocean).

O-2 All to ocean, no P treatment

	wastewater quality	Assumed background	Dilution @ 100m (x-fold)	Concentration @100m	One Plan Target for seawater
TSS	40	10	100	10.3	none
TP	4.5	0.005	100	0.05	0.01
TN	35	0.03	100	0.38	0.06
ammonia-N	22	0.01	100	0.23	0.5

Table 3 from PDP (2020b) used to assess N uptake from land treatment systems

Table 1: Summary of Estimated Total Yearly Nitrogen Loss via Leaching and Nitrogen Uptake via Crop Growth

Options	PDP Leaching Estimate (kg N/ha/yr)	Total Mass of N Leached (kg/yr)	Estimated Nitrogen Uptake Rate (kg N/ha/yr)[1]	Total Mass of N Taken Up (kg/yr)
L + R(a)	20	45,000	170	383,000
L + R(b)	15	23,000	65	100,000
L + R(d) – 80	15	18,000	150	185,000
L + R(d) – 62.2	15	15,000	150	150,000

Table 1: Summary of Estimated Total Yearly Nitrogen Loss via Leaching and Nitrogen Uptake via Crop Growth				
L + R(e) – 80 (TN = 10 mg/L)	20	16,000	65	52,000
L + R(e) – 62.2 (TN = 10 mg/L)	17.5	12,000	60	43,000
Dual R+L (c)	20	10,000	135	71,000
Dual R+L (b)	20	14,000	135	92,000
O + L (TN = 10 mg/L)	10	4,500	55	23,000
R2(b) – 50%	7.5	2,500	5	1,000
R2(b) – 75%	7.5	3,500	5	1,000

Notes

1. *Nitrogen uptake estimate excludes any fertiliser that may be applied to increase crop yield.*

1 Public Health Risk Comparative Qualitative Assessment of Short-listed Options

1.1 Introduction

This report sets out the Public Health Risk comparative qualitative assessment of the short-listed options for the Palmerston North Wastewater BPO project ("Nature Calls"). The output of this paper will be used in Multicriteria Assessment (MCA) of the shortlisted options.

The draft report was prepared by:

- Sue Bennett, Principal Environmental Scientist, Stantec, Author
- Jim Bradley, Public Health Engineer, Stantec, Reviewer

The following personnel have been involved with the development of the paper prior to the MCA workshop:

- Aslan Perwick, Groundwater Services Leader, PDP (Land application options)
- David Cameron, Principal Environmental Scientist, Stantec (Ocean outfall options)
- Olivier Ausseil, River Scientist, Aquanet (River discharge options)

The following representatives from public health have provided input and advice into the methodology and assessment of exposure pathways, which has been invaluable. Their contribution is gratefully recognised especially given the constraints on their time at the current time. They have not undertaken a detailed review of the assessment and do not provide an endorsement of the results of the assessment:

- Dr Stephen Palmer, Medical Officer of Health, MidCentral Public Health Services
- Brett Munro, Health Protection Officer, MidCentral Public Health Services

1.2 Criterion and Scoring Approach

To the authors knowledge, there is no published, standard method for undertaking a qualitative assessment of public health risk associated with the discharge of treated wastewater. The methodology used in this assessment has been developed based on the standard risk assessment matrix approach coupled with the exposure pathway methodology previously adopted by some members of this project team for the Ruakaka wastewater project undertaken for Whangarei District Council. This project involved the comparison of a number of options in a qualitative way based on an exposure pathway assessment and an assessment of the degree of difficulty in controlling public health risks.

The authors note that there is an established methodology for the Quantitative Public Health Risk Assessment or Quantitative Microbial Risk Assessment (QPHRA or QMRA) and we understand that this will be undertaken for the preferred Best Practicable Option (BPO) to support consent applications. The authors have developed three potential criteria that could be used to assess the risk to public health from the shortlisted options.

The first criterion is based on a qualitative assessment of the degree to which the option has the potential to result in health risks to the public as a result of exposure to treated wastewater. As elaborated on below this is based on the critical (lowest) MCA score of all pathways assessed. This follows a precautionary principle.

The second and third criteria are based on the number of exposure pathways that have been conceptualised for each option. This relates to the extent to which the treated wastewater can interact with the public and hence the degree of difficulty in controlling the public health risks and extent of the control measures that will need to be implemented in order to mitigate the identified risks. These criteria can be developed based on either on the total number of all conceptualised exposure pathways (criterion 2) or on the number of identified critical exposure pathways (criterion 3).

The scoring approach for all three criteria is given in Table 1 and half scores in the 1 to 5 range will be used as necessary when the risk falls between a whole a number. The options have been scored against all three criteria and are provided for consideration to the MCA workshop.

Table 1: MCA scoring

Criterion	Description	MCA score:	1	2	3	4	5
Public Health 1	Potential for health risk to the public as a result of exposure to treated wastewater (including through land application) based on qualitative assessment of public health risk	Narrative description of MCA score:	extreme	high	medium	low	none[1]
2	Potential for health risk to the public as a result of exposure to treated wastewater (including through land application) based on potential degree of difficulty in controlling public health risk	Number of all conceptualised exposure pathways	Option with most exposure pathways	Rated according to number of pathways			Option with least exposure pathways
3	Potential for health risk to the public as a result of exposure to treated wastewater (including through land application) based on potential degree of difficulty in controlling public health risk	Number of critical exposure pathways	Option with most exposure pathways	Rated according to number of pathways			Option with least exposure pathways

[1] None: indicates that there were no exposure pathways for the option where treated wastewater could reach the public.

1.3 Approach to the assessment

1.3.1 Qualitative Risk Matrix

The health risk to the public is assessed through the qualitative assessment of individual exposure pathways from the discharge of the treated wastewater to the member(s) of the public who is/are placed at risk. All complete conceivable exposure pathways are considered for each option with each pathway being scored. A complete exposure pathway is one where the treated wastewater will reach the member of the public. Any conceived incomplete exposure pathways will be documented for completeness.

Given that this is a public health assessment and hence we have adopted the precautionary principle, the overall score used for the option will be the critical (lowest) score of all the pathways assessed.

The approach to the public health risk assessment is a qualitative assessment based on the expertise and judgements of the specialist authors.

The scale of the public health effect that could result from the exposure scenario is considered as well as the frequency with which it may occur over the course of a 35 year consent term (the maximum allowed under the RMA). These factors are assessed and combined using the framework in Table 2.

Given that Table **2** forms the basis for the allocation of the risk rating, it is important, that the authors review and accept the form of the table and the allocation of the ratings to the various scales and frequencies of event. This should be reviewed as part of the assessment workshop.

Table 2: Qualitative Risk Matrix

		Scale of Public Health Effect				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Frequency of Exposure	Almost Certain	*High*	*High*	*Extreme*	*Extreme*	*Extreme*
	Likely	*Medium*	*High*	*High*	*Extreme*	*Extreme*
	Possible	*Low*	*Medium*	*High*	*Extreme*	*Extreme*
	Unlikely	*Low*	*Low*	*Medium*	*High*	*Extreme*
	Rare	*Low*	*Low*	*Low*	*Medium*	*High*
	None	*None*	*None*	*None*	*None*	*None*

For each exposure pathway, the "scale of the public health effect" from the exposure to the pathogens or contaminants in the treated wastewater resulting from the exposure pathway will be rated according to the classes in the columns (i.e. insignificant, minor, moderate, major, catastrophic). The general definitions of the scale of the public health effects that has been followed in the assessment are:

- Insignificant: illness resulting from the treated wastewater discharge is indiscernible above the normal background level of illness in the community.
- Minor: health effects are limited to a single person, single household or single group of people who can be readily identified and contacted by the public health authorities and the consent holder for appropriate advice who experience a minor illness
- Moderate: health effects affect a larger group of people across a wider area, which requires a larger scale of public health response with contact tracing. All persons affected only experience a minor illness
- Major: health effects affect a larger group of people across a wider area, which requires a larger scale of public health response with contact tracing. All persons affected only experience a moderate illness, which may be dangerous to sensitive members of the community
- Catastrophic: health effects affect a larger group of people across a wider area, which requires a larger scale of public health response with contact tracing. All persons affected only experience a major illness, which is likely to be dangerous to sensitive members of the community

Then, the "frequency of exposure" with which the exposure pathway could occur is also rated with the classes in the rows (i.e. almost certain, likely, possible, unlikely, rare, none). These frequencies are defined by considering the number of potential incidences of the public health effect occurring over the potential 35 year period of the consent term.

The body of Table **2** (coloured section, red, orange, yellow, green, blue) is used to combine the two ratings of the scale and frequency of the exposure pathway into a qualitative risk rating (i.e. low, medium, high, extreme).

If no conceivable exposure pathway can be developed that can connect the treated wastewater to the public, then the public health risk will be rated as none and the MCA will be 5 as given in Table 1.

1.3.2 Definition of Exposure Pathway

The components of the exposure pathways that will be developed are:

- the discharge points from which the treated wastewater could be released from the infrastructure (outfall, spray irrigation through land application system, wetland, land passage, pipeline)
- the environment between the point of release and the potential exposure sites to the public
- the exposure route through which the public comes into contact with the treated wastewater.

The normal operation and the conceivable other discharge scenarios will be considered separately and will include:

- primary discharge site, being the outfall or land application site. This will include discharge:
    - to fresh and marine waters

  - to land
  - to air through aerosol/spray
- conceivable other discharge scenarios between the wastewater treatment plant (WWTP) and the primary discharge site, such as pipeline breakage, spillage, or overflow.

The interactions between the treated wastewater and the environment will significantly alter the nature of the risk being posed particularly in terms of dilution and frequency of exposure. A conceptual model of the transfer of the treated wastewater from the discharge point to the exposure site will be developed for each pathway. This will be developed for the conceptual exposure site that in the judgement of the authors would result in the highest potential for risk (i.e. the site which combines the most number of people exposed, the lowest level of dilution prior to exposure, etc).

The potential exposure routes that will be considered are:

- Recreation
  - Primary contact[2]
  - Secondary contact[3]
  - Public recreation within the land application land holding area[4]
- Food gathering and consumption (shellfish, fish, watercress etc.)[5]
  - Recreational
  - Commercial / aquaculture
  - Customary
- Drinking water
  - Surface water
  - Groundwater
  - Tank water[6]
- Inhalation[6]

[2] recreational activities such as swimming, paddling, boating, or watersports, and particularly for activities where there is a high likelihood of water or water vapour being ingested or inhaled (based on NPS-FM 2020)
[3] People's contact with fresh water that involves only occasional immersion and includes wading or boating (except boating where there is high likelihood of immersion).
[4] Assumed that adequate controls would be included to ensure separation from active treated wastewater application areas.
[5] Risk from gathering in surface water affected by treated wastewater and also potentially crops and animals affected by spray drift and impacted stock water
[6] Risk associated with spray drift from land application

1.4 Assumptions applied in the Assessment

In undertaking the assessment, the following assumptions have been made:

- Assumes that the wastewater is treated to sufficient standard that public health risk associated with the primary discharge site are considered acceptable and would be consentable. The wastewater for each route will be treated using different treatment methods and hence be of different qualities as required to achieve the required protection of environmental effects. The different treatment methods and resultant pathogen and contaminant loads are noted in the following assessment tables. We note that given this assumption, all options should be rated with a risk of low. However, each option is not yet fully developed. Each option has been assessed in accordance with our current understanding of the controls that have been included in the design and costing at this stage in the project. This has meant that some options have been given a risk rating of medium. It is expected that if these options are carried forward as the preferred BPO option then the exposure pathways will be rigorously assessed as part of the further development of the option such that the risk of all exposure pathways for the option are reduced to low.
- The assessment does not consider “out of specification” wastewater, or wastewater with pathogens or contaminants which are significant greater than anticipated by the design and operation of the WWTP and included in the consent conditions.[7]
- The assessment is undertaken assuming that there is no significant outbreak of illness in the community which would cause elevated concentrated of pathogens in the wastewater. The impact of this effect will be assessed at the stage of the quantitative public health risk assessment for the selected option.
- The public health risk considered for the exposure pathways includes that from pathogens for all exposure pathways, and nitrogen for the water supply pathway. The assessment of water supply is on the basis of the maximum acceptable value for nitrate concentrations of 50 mg nitrate /L (equivalent to 11.8 mg-N/L) in NZDWS 2018[8]
- Risk from emerging contaminants and heavy metals to human health is not considered in this assessment. Whilst these are important for the assessment of the impact of the discharges on aquatic and soil ecosystems, they are not considered relevant to human health at this level
- The following matters have not been included in this assessment
    - Worker contact (outside WWTP) as a result of management of land application areas and operations in conjunction with farming. This would be covered by appropriate work safe practices with appropriate training and PPE and hence is excluded
    - Worker contact as a result of pipe breakages, as above
    - Worker contact within the WWTP and wetlands / land passage, as above
    - Odour generation – this is considered to be a nuisance effect
    - Mental health / perception – this is addressed under the Social and Community considerations criterion
    - Māori health and wellbeing following the Mason Durie Model or other acceptable model or approaches
- Wastewater beneficial reuse options that could be part of any option e.g. irrigation of reserves and golf courses, industrial reuse and others have not been included in this assessment. (Refer to other work packages for beneficial reuse/resource recovery options)

[7] Incidents involving discharge of “out of specification” wastewater will be managed to reduce public exposure and hence risks appropriately.
[8] Note that concern about potential risk of bowel cancer associated with nitrate in drinking water at lower concentrations is not assessed.

- For those options where there can be a 3% discharge to the Manawatu River (to cover exceptional circumstances), this discharge has not been included in the assessment as it is expected to occur at times of exceptionally high river flows.

1.5 Assessment

1.5.1 Option naming

The following are the Short-listed Options and naming as is being used for all criteria. The areas of the land schemes are shown in the maps as indicated. These areas are the nominal areas of the schemes and include buffer zones and set backs as appropriate. Irrigation will not be undertaken to the entire area.

Table 3: Shortlisted Options

Option[9]	Variant
1: R2(b)	River discharge with enhanced treatment
	River discharge with enhanced treatment, and a small % to land on fluvial plane
2: Dual R + L	Two river discharge points and a small % to land
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time
	55 % applied to an inland land application site and a river discharge for the remainder of the time
	45 % applied to a coastal land application site and a river discharge for the remainder of the time
	55 % applied to a coastal land application site and a river discharge for the remainder of the time
6: Ocean	Ocean discharge, with a small % to land
	Ocean discharge

The sub-options for treated wastewater applied to an land application site and a river discharge for the remainder of the time (L + R (d) & (e)) for 45% and the 55% are considered the same for this assessment will not be separately scored.

1.5.2 Option Assessment

Table 4 is a summary of the MCA qualitative public health risk score determined as set out above.

[9] Option 5 has been deleted from the shortlist

Table 5 is a summary of the difficulty in controlling public health risk. Criterion 2 includes all exposure pathways. Criterion 3 includes the number of critical exposure pathways. Draft MCA scores are given for both cases.

Appendix 1 (tables 6-14) contains the detailed assessment exposure pathways that has been completed for each option to document all the exposure pathways considered. All assumptions and definitions made in the table are documented in footnotes to the tables.

Where options include multiple discharge options, i.e. discharge to land and ocean or river, all exposure pathways for all routes will be assessed for the options. Where options have different relative proportions of the same elements (i.e. 55% land and 45% river versus 97% land and 3% river), the assessment of the scale of risk will be the same for the exposure pathways. However, there could be an assessed difference in the frequency of exposure. This has resulted in differences between options.

The critical exposure pathways have been identified in bold in the Appendix 1 tables for each of the options.

1.6 Assessment Summary

Table 4 and Table 5 sets out the preliminary assessment of the options by the authors according to the three criteria proposed in this assessment. This will be used as a starting point for discussion at the MCA workshop. Any change to the public health scoring will be performed while the public health experts are available for discussion. The final MCA assessment and score may therefore differ from what is set out below. We recommend that the MCA workshop adopt the rating developed from the degree of difficulty in controlling potential for public health risk based on the number of critical exposure pathways as highlighted in bold in Table 5. Figure 1 shows the range of scores as a bar chart.

Table 4: MCA Score Summary based on Qualitative Public Health Risk (Criterion 1)

Options[10]	Option Description	Critical Qualitative Risk Rating	Draft MCA Score
1: R2(b)	River discharge with enhanced treatment	High	2
	River discharge with enhanced treatment, and a small % to land	High	2
2: Dual R + L	Two river discharge points and a small % to land	High	2
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	High	2
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	High	2
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	High	2
	55 % applied to an inland land application site and a river discharge for the remainder of the time	High	2
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	High	2
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	High	2
6: Ocean	Ocean discharge, with a small % to land	High	2
	Ocean discharge	High	2

[10] Option 5 has been deleted from the short list.

Table 5: MCA Score Summary based on degree of difficulty in controlling public health risk (Criteria 2 and 3)

Options[11]	Option Description	Number of all exposure pathways (Criterion 2)	Draft MCA score	Number of critical exposure pathways (Criterion 3)	Draft MCA Score
1: R2(b)	River discharge with enhanced treatment	9	3	4	**4**
	River discharge with enhanced treatment, and a small % to land	28	1	6	**2.5**
2: Dual R + L	Two river discharge points and a small % to land	28	1	4	**4**
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	19	1.5	5	**3**
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	20	1.5	4	**4**
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	28	1	5	**3**
	55 % applied to an inland land application site and a river discharge for the remainder of the time	28	1	5	**3**
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	29	1	8	**2**
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	29	1	8	**2**
6: Ocean	Ocean discharge, with a small % to land	20	1.5	6	**2.5**
	Ocean discharge	6	5	3	**5**

[11] Option 5 has been deleted from the short list.

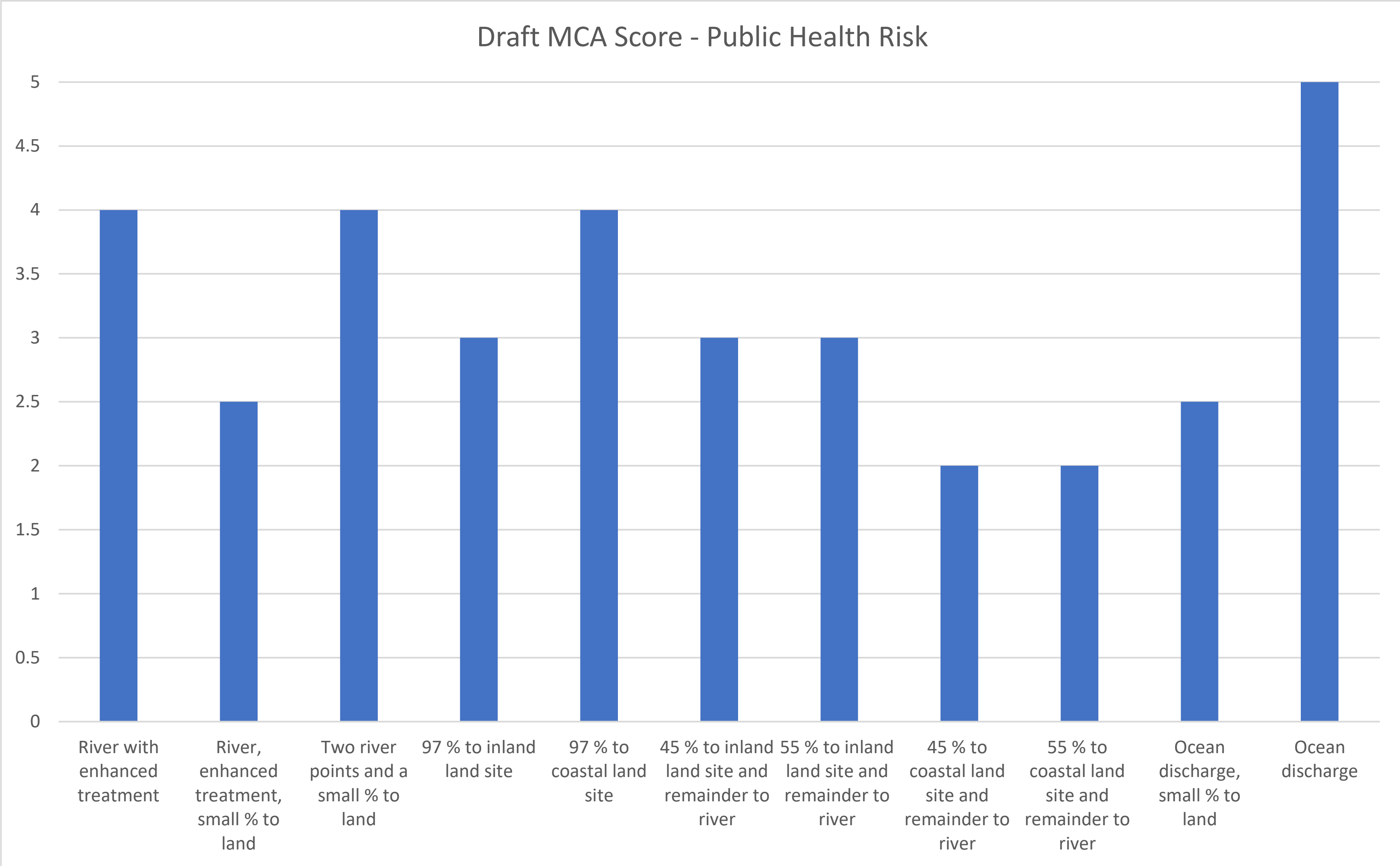


Figure 1: Recommended Draft MCA Scores based on degree of difficulty in controlling potential for public health risk based on the number of critical exposure pathways

Appendix 1: Public Health Risk Tables: Detailed Assessment of Exposure Pathways

Option 1 R2(b) River Discharge with Enhanced Treatment

#	Exposure Pathways - Option 1 R2(b)	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
1	**main discharge[12] direct to Manawatu River at WWTP with contact recreation in river downstream above Opiki**	**Moderate[13]**	**Likely**	**High**
2	**main discharge direct to Manawatu River at WWTP with contact recreation in river downstream below Opiki**	**Minor**	**Almost Certain**	**High**
3	main discharge direct to Manawatu River at WWTP with water take for current untreated domestic drinking water from river downstream	Moderate	Rare/None[14]	Low/None
4	main discharge direct to Manawatu River at WWTP with water take for potential future untreated domestic drinking water from river downstream	Moderate	Rare/Unlikely	Low/medium
5	main discharge direct to Manawatu River at WWTP with recreational food gathering of water cress from river downstream	Moderate	Unlikely	Medium
6	**main discharge direct to Manawatu River at WWTP with recreational food gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**
7	**main discharge direct to Manawatu River at WWTP with current or potential customary or commercial food gathering of shellfish, fish (incl eels) from river downstream**	**Minor**	**Likely**	**High**

[12] Enhanced treatment with membrane and UV, therefore very low levels of pathogens.
[13] Due to very high level of treatment with multiple barriers. With distance downstream, dilution increases and hence risk of illness reduces. The risk of illness from the treated wastewater will need to be assessed in more detail in later stages of the project.
[14] There are no current consented water takes from the Manawatu River. However, there may be takes under the permitted activity rules.

#	Exposure Pathways - Option 1 R2(b)	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
8	main discharge to wetland before discharge to Manawatu River - recreational gathering of water cress from wetland	Insignificant/minor[15]	Rare/None[16]	Low/None
9	main discharge to wetland before discharge to Manawatu River - recreational gathering of shellfish, fish or eels from wetland	Insignificant/minor	Rare/None	Low/None
	Resultant Risk level for Option: (critical of all pathways)			**High**

[15] If birds gather on the wetland then some potential for pathogens carried by birds to be deposited in the wetlands. However current design is for fully vegetated wetlands which are less attractive to birds which reduces this risk.
[16] Public access to the wetland will be restricted as it is part of the WWTP.

Option 1 R2(b) River discharge with enhanced treatment, and a small % to land at enhance treatment (50% of the dry weather flows when river flows are low)

#	Exposure Pathways - Option 1 R2(b) with land	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
1	**main discharge[17] direct to Manawatu River at WWTP with contact recreation in river downstream above Opiki**	**Moderate[18]**	**Likely**	**High**
2	**main discharge direct to Manawatu River at WWTP with contact recreation in river downstream below Opiki**	**Minor**	**Almost certain**	**High**
3	main discharge direct to Manawatu River at WWTP with water take for drinking water from river downstream	Moderate	Rare/None	Low/None
4	main discharge direct to Manawatu River at WWTP with water take for potential future untreated domestic drinking water from river downstream	Moderate	Rare/unlikely	Low/medium
5	main discharge direct to Manawatu River at WWTP with recreational food gathering of water cress from river downstream	Moderate	Unlikely	Medium
6	**main discharge direct to Manawatu River at WWTP with recreational food gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**
7	**main discharge direct to Manawatu River at WWTP with current or potential customary or commercial food gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**
8	main discharge to wetland before discharge to Manawatu River - recreational gathering of water cress from wetland	Insignificant/minor[19]	Rare/None[20]	Low/None

[17] Enhanced treatment with membrane and UV, therefore very low levels of pathogens.
[18] Due to very high level of treatment with multiple barriers. With distance downstream, dilution increases and hence risk of illness reduces. The risk of illness from the treated wastewater will need to be assessed in more detail in later stages of the project.
[19] If birds gather on the wetland then some potential for pathogens carried by birds to be deposited in the wetlands. However current design is for fully vegetated wetlands which are less attractive to birds which reduces this risk.
[20] Public access to the wetland will be restricted as it is part of the WWTP.

#	Exposure Pathways - Option 1 R2(b) with land	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
9	main discharge to wetland before discharge to Manawatu River - recreational gathering of shellfish, fish or eels from wetland	Insignificant/minor	Rare/None	Low/None
10	**main discharge to land then shallow groundwater to bore used as domestic water supply[21]**	**Insignificant[22]**	**Almost certain**	**High**
11	main discharge to land then shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as commercial water supply for horticulture or irrigation[23]	Insignificant[24]	Rare[25]	Low
12	main discharge to air then spray drift[26] to neighbours within application area and inhaled	Insignificant	Rare[27]	Low
13	main discharge to air then spray drift to neighbour's roof used to supply tank water for untreated domestic water supply	Insignificant	None[28]	None
14	main discharge to air then spray drift to public recreating on land within land application area[29]	Insignificant	Rare	Low
15	main discharge to land then shallow groundwater to Manawatu River with contact recreation in river above Opiki	Insignificant	Possible	Low

[21] All bores within scheme are replaced or appropriately managed with public water supply so only bores outside of scheme are potentially affected and assessed here. Domestic water supply bores have small drawdown zone of 10m and hence risk of incorporating groundwater affected by treated wastewater plume is insignificant.
[22] Given level of treatment through WWTP and land and at least 600m of distance through aquifer, large removal of pathogens expected. Increase in nitrate concentrations as a result of the treated wastewater application is expected to be less than NZDWS 2018 MAV. Note that groundwater concentration may already be elevated.
[23] A commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route.
[24] Given level of treatment through WWTP and land and at least 100m of distance through aquifer, large removal of pathogens expected. Given the larger volume of use and the wider number of people potentially exposed to the pathogens, the scale of the effect is considered larger than the domestic water supply bore.
[25] As part of the scheme all bores in the application area will be sealed to prevent this pathway, however some bores may be missed and hence there is a risk that this route may remain open.
[26] Centre pivot with wind control with buffer zones and wind planting included around the schemes.
[27] Mitigation measures render spray drift of aerosol to neighbours rare
[28] Assume that all potentially affected houses will be provided with alternative domestic water supply
[29] Assume that public will be kept from the active spray areas and hence any exposure to spray drift will be subsequent to adequate mitigation measures

#	Exposure Pathways - Option 1 R2(b) with land	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
16	**main discharge to land then shallow groundwater to Manawatu River with contact recreation in river downstream below Opiki**	**Insignificant**	**Almost Certain**	**High**
17	main discharge to land then shallow groundwater to Manawatu River with water take for current or potential future untreated domestic drinking water from river downstream	Insignificant	Rare	Low
18	main discharge to land then shallow groundwater to Manawatu River with recreational and customary gathering of water cress from river downstream	Insignificant	Unlikely	Low
19	main discharge to land then shallow groundwater to Manawatu River with recreational and customary food gathering of shellfish, fish (incl eels) from river downstream	Insignificant	Likely	Medium
20	main discharge to land then shallow groundwater to Manawatu River with current or potential commercial food gathering of shellfish, fish (incl eels) from river downstream	Insignificant	Likely	Medium
21	main discharge to land then shallow groundwater then streams and drains with contact recreation in streams[30]	Insignificant	Possible[31]	Low
22	main discharge to land then shallow groundwater then streams and drains with recreational gathering of water cress, shellfish or fish (incl eels) from streams and drains	Minor	Possible	Medium
23	main discharge to land then shallow groundwater then streams and drains with customary gathering of watercress, shellfish or fish (incl eels) from streams and drains	Minor	Unlikely[32]	Low

[30] Assume that primary contact not feasible in streams and drains due to depth and nature of streams
[31] Access to the >3000ha application area will be controlled and hence incidence of collection from streams and drains will be reduced. All streams downstream of the application (to the west) could be impacted by the treated wastewater and is included in this pathway.
[32] To reduce the public health risk, any stream or drain potentially impacted by the treated wastewater plume would be excluded from a customary or commercial gathering operation. The mechanism for this would need to be codified.

#	Exposure Pathways - Option 1 R2(b) with land	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
24	main discharge to land then shallow groundwater then streams and drains with current or potential commercial gathering of shellfish or fish (incl eels) from streams and drains	Minor	Unlikely	Low
25	main discharge to land then direct[33] as surface runoff to streams and drains with secondary contact recreation in streams within the application area	Insignificant	Rare	Low
26	transfer pipe breakage[34] discharge of treated WW to surface water[35] where contact recreation occurs	Minor	Rare	Low
27	transfer pipe breakage discharge of treated WW to shallow groundwater to bore used as domestic water supply[36]	Minor	Rare	Low
28	transfer pipe breakage discharge of treated WW to land then surface water or shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as municipal or commercial water supply for horticulture or irrigation[37]	Minor	Rare	Low
	Resultant Risk level for Option: (critical of all pathways)			**High**

[33] The land application areas will be designed, operated and maintained to ensure that surface runoff is minimised and that applied treated wastewater is discharge via land to the shallow groundwater. Therefore this pathway is considered to be rare for all the exposure pathways associated with this discharge route.
[34] Pipe normally below ground, but pressure from pumping will result in high pressure release at the surface of the treated wastewater. Stream crossing will be below or as pipe bridges but will be above ground.
[35] The pipeline between the WWTP and the outfall crosses a number of minor tributaries with low flow and no major recreational areas. No swimming areas, so would be suitable for wading / playing and not swimming.
[36] It is assumed that any pipe break can be identified within 24 hour timeframe, and any impacted private bores would be identified and its use would be stopped. During the design phase, all water supply bores in the vicinity of the route will be identified and a log of the contact details of the water supplies by the scheme operator will be maintained during the life of the scheme to facilitate the public health response.
[37] A municipal or commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route. We assume that the municipal supply will include treatment which will reduce risk and any commercial operation can control subsequent supply of product to the public to minimise exposure.

Option 2: Dual R+L Two river discharge points and a small % to land (all of treated wastewater to land at low river flow)

#	Exposure Pathways - Option 2: Dual R+L	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
1	main discharge[38] direct to Manawatu River at WWTP or Opiki with contact recreation in river downstream above Opiki	Moderate	Unlikely[39]	Medium
2	main discharge direct to Manawatu River at WWTP or Opiki with contact recreation in river downstream below Opiki	Minor	Possible	medium
3	main discharge direct to Manawatu River at WWTP or Opiki with water take for untreated domestic drinking water from river downstream	Moderate[40]	Rare/None	Low/None
4	main discharge direct to Manawatu River at WWTP or Opiki with water take for potential future untreated domestic drinking water from river downstream	Moderate	Rare/None	Low/None
5	main discharge direct to Manawatu River at WWTP or Opiki with recreational gathering of water cress from river downstream	Minor	Unlikely	Low
6	**main discharge direct to Manawatu River at WWTP or Opiki with recreational gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**
7	**main discharge direct to Manawatu River at WWTP with current or potential customary or commercial food gathering of shellfish, fish (incl eels) from river downstream**	**Minor**	**Likely**	**High**
8	main discharge to wetland before discharge to Manawatu River - recreational gathering of water cress from wetland	Insignificant/minor[41]	Rare/None[42]	Low/None

[38] Biological treatment with clarification and UV, residual level of pathogens remain
[39] During low flow discharge will be removed from the river to land, during slightly higher flow discharge will be at Opiki below which the river is not conducive to significant contact recreation due to its form. Discharge direct to the river just below the WWTP is only during higher river flows when dilution is higher and contact recreation is less prevalent.
[40] There will significant dilution in the river by the point of any take given the discharge scenario which would reduce the risk, however, there is not as high a level of treatment as the river only option.
[41] If birds gather on the wetland then some potential for pathogens carried by birds to be deposited in the wetlands. However current design is for fully vegetated wetlands which are less attractive to birds which reduces this risk.
[42] Public access to the wetland will be restricted as it is part of the WWTP.

#	Exposure Pathways - Option 2: Dual R+L	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
9	main discharge to wetland before discharge to Manawatu River - recreational gathering of shellfish, fish or eels from wetland	Insignificant/minor	Rare/None	Low/None
10	**main discharge to land then shallow groundwater to bore used as domestic water supply[43]**	**Insignificant[44]**	**Almost certain**	**High**
11	main discharge to land then shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as commercial water supply for horticulture or irrigation[45]	Moderate[46]	Rare[47]	Low
12	main discharge to air then spray drift[48] to neighbours within application area and inhaled	Moderate	Rare[49]	Low
13	main discharge to air then spray drift to neighbour's roof used to supply tank water for untreated domestic water supply	Moderate	None[50]	None
14	main discharge to air then spray drift to public recreating on land within land application area[51]	Moderate	Rare	Low
15	main discharge to land then shallow groundwater to Manawatu River with contact recreation in river above Opiki	Moderate	Unlikely[52]	Medium

[43] All bores within scheme are replaced or appropriately managed with public water supply so only bores outside of scheme are potentially affected and assessed here. Domestic water supply bores have small drawdown zone of 10m and hence risk of incorporating groundwater affected by treated wastewater plume is insignificant.
[44] Given level of treatment through WWTP and ground and at least 600m of distance through aquifer, large removal of pathogens expected. Increase in nitrate concentrations as a result of the treated wastewater application is expected to be less than NZDWS 2018 MAV. Note that groundwater concentration may already be elevated.
[45] A commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route.
[46] Given level of treatment through WWTP and ground and at least 100m of distance through aquifer, large removal of pathogens expected. Given the larger volume of use and the wider number of people potentially exposed to the pathogens, the scale of the effect is considered larger than the domestic water supply bore.
[47] As part of the scheme all bores in the application area will be sealed to prevent this pathway, however some bores may be missed and hence there is a risk that this route may remain open.
[48] Centre pivot with wind control with buffer zones and wind planting included around the schemes.
[49] Mitigation measures render spray drift of aerosol to neighbours rare
[50] Assume that all potentially affected houses will be provided with alternative domestic water supply
[51] Assume that public will be kept from the active spray areas and hence any exposure to spray drift will be subsequent to adequate mitigation measures
[52] Treated wastewater discharge is not directed to river when most recreation activity would occur

#	Exposure Pathways - Option 2: Dual R+L	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
16	**main discharge to land then shallow groundwater to Manawatu River with contact recreation in river downstream below Opiki**	**Moderate**	**Possible**	**High**
17	main discharge to land then shallow groundwater to Manawatu River with water take for current or potential future untreated domestic drinking water from river downstream	Insignificant/minor	Rare	Low
18	main discharge to land then shallow groundwater to Manawatu River with recreational gathering of water cress from river downstream	Insignificant/minor	Unlikely	Low
19	main discharge to land then shallow groundwater to Manawatu River with recreational food gathering of shellfish, fish (incl eels) from river downstream	Insignificant/minor[53]	Likely	Medium/high
20	main discharge to land then shallow groundwater to Manawatu River with current or potential commercial food gathering of shellfish, fish (incl eels) from river downstream	Insignificant/minor	Likely	Medium/high
21	main discharge to land then shallow groundwater then streams and drains with contact recreation in streams[54]	Minor	Possible[55]	Medium
22	main discharge to land then shallow groundwater then streams and drains with recreational gathering of water cress, shellfish or fish (incl eels) from streams and drains	Minor	Possible	Medium
23	main discharge to land then shallow groundwater then streams and drains with customary gathering of watercress, shellfish or fish (incl eels) from streams and drains	Minor	Unlikely[56]	Low

[53] Scheme is not being operated to optimise land treatment, therefore cannot reduce scale of public health effect to reflect probable increased treatment through land resulting from application during low river flow.
[54] Assume that primary contact not feasible in streams and drains due to depth and nature of streams
[55] Access to the 970ha application area will be controlled and hence incidence of collection from streams and drains will be reduced. All streams downstream of the application (to the west) could be impacted by the treated wastewater and is included in this pathway.
[56] To reduce the public health risk, any stream or drain potentially impacted by the treated wastewater plume would be excluded from a customary or commercial gathering operation. The mechanism for this would need to be codified.

#	Exposure Pathways - Option 2: Dual R+L	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
24	main discharge to land then shallow groundwater then streams and drains with current or potential commercial gathering of shellfish or fish (incl eels) from streams and drains	Minor	Unlikely	Low
25	main discharge to land then direct[57] as surface runoff to streams and drains with contact recreation in streams within the application area	Minor	Rare	Low
26	transfer pipe breakage[58] discharge of treated WW to surface water[59] where contact recreation occurs	Moderate	Rare	Low
27	transfer pipe breakage discharge of treated WW to shallow groundwater to bore used as domestic water supply[60]	Moderate	Rare	Low
28	transfer pipe breakage discharge of treated WW to land then surface water or shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as municipal or commercial water supply for horticulture or irrigation[61]	Moderate	Rare	Low
	Resultant Risk level for Option: (critical of all pathways)			**High**

[57] The land application areas will be designed, operated and maintained to ensure that surface runoff is minimised and that applied treated wastewater is discharge via land to the shallow groundwater. Therefore this pathway is considered to be rare for all the exposure pathways associated with this discharge route.

[58] Pipe normally below ground, but pressure from pumping will result in high pressure release at the surface of the treated wastewater. Stream crossing will be below or as pipe bridges but will be above ground.

[59] The pipeline between the WWTP and the outfall crosses a number of minor tributaries with low flow and no major recreational areas. No swimming areas, so would be suitable for wading / playing and not swimming.

[60] It is assumed that any pipe break can be identified within 24 hour timeframe, and any impacted private bores would be identified and its use would be stopped. During the design phase, all water supply bores in the vicinity of the route will be identified and a log of the contact details of the water supplies by the scheme operator will be maintained during the life of the scheme to facilitate the public health response.

[61] A municipal or commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route. We assume that the municipal supply will include treatment which will reduce risk and any commercial operation can control subsequent supply of product to the public to minimise exposure.

Option 3: L+R (a) 97 % applied to an inland land application site and a discharge to river in exceptional circumstances

#	Exposure Pathways - Option 3: L+R (a) inland	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
1	main discharge[62] to land then shallow groundwater to bore used as domestic water supply[63]	Insignificant[64]	Possible[65]	Low
2	main discharge to land then shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as commercial water supply for horticulture or irrigation[66]	Moderate[67]	Rare[68]	Low
3	main discharge to air then spray drift[69] to neighbours within application area and inhaled	Moderate	Rare[70]	Low
4	main discharge to air then spray drift to neighbour’s roof used to supply tank water for untreated domestic water supply	Moderate	None[71]	None
5	main discharge to air then spray drift to public recreating on land within land application area[72]	Moderate	Rare	Low
6	**main discharge to land then shallow groundwater to Manawatu River with contact recreation in river above Opiki**	**Moderate**	**Possible**	**High**

62 Biological treatment with clarification and UV, residual level of pathogens remain
63 All bores within scheme are replaced or appropriately managed with public water supply so only bores outside of scheme are potentially affected and assessed here. Domestic water supply bores have small drawdown zone of 10m and hence risk of incorporating groundwater affected by treated wastewater plume is insignificant.
64 Given level of treatment through WWTP and land and at least 600m of distance through aquifer, large removal of pathogens expected. Increase in nitrate concentrations as a result of the treated wastewater application is expected to be less than NZDWS 2018 MAV. Note that groundwater concentration may already be elevated.
65 Low density of population results in low potential for drinking bores
66 A commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route.
67 Given level of treatment through WWTP and land and at least 600m of distance through aquifer, large removal of pathogens expected. Given the larger volume of use and the wider number of people potentially exposed to the pathogens, the scale of the effect is considered larger than the domestic water supply bore.
68 As part of the scheme all bores in the application area will be sealed to prevent this pathway, however some bores may be missed and hence there is a risk that this route may remain open.
69 Centre pivot with wind control with buffer zones and wind planting included around the schemes.
70 Mitigation measures render spray drift of aerosol to neighbours rare
71 Assume that all potentially affected houses will be provided with alternative domestic water supply
72 Assume that public will be kept from the active spray areas and hence any exposure to spray drift will be subsequent to adequate mitigation measures

#	Exposure Pathways - Option 3: L+R (a) inland	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
7	**main discharge to land then shallow groundwater to Manawatu River with contact recreation in river downstream below Opiki**	**Minor**	**Almost certain**	**High**
8	main discharge to land then shallow groundwater to Manawatu River with water take for current or potential future untreated domestic drinking water from river downstream	Insignificant/minor	Rare	Low
9	main discharge to land then shallow groundwater to Manawatu River with recreational gathering of water cress from river downstream	Insignificant/minor	Unlikely	Low
10	**main discharge to land then shallow groundwater to Manawatu River with recreational food gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**
11	**main discharge to land then shallow groundwater to Manawatu River with current or potential customary or commercial food gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**
12	main discharge to land then shallow groundwater then streams and drains with contact recreation in streams[73]	Insignificant	Possible[74]	Low
13	**main discharge to land then shallow groundwater then streams and drains with recreational gathering of water cress, shellfish or fish (incl eels) from streams and drains**	**Moderate**	**Possible**	**High**
14	main discharge to land then shallow groundwater then streams and drains with customary gathering of watercress, shellfish or fish (incl eels) from streams and drains	Moderate	Unlikely[75]	Medium

[73] Assume that primary contact not feasible in streams and drains due to depth and nature of streams
[74] Access to the >3000ha application area will be controlled and hence incidence of collection from streams and drains will be reduced. All streams downstream of the application (to the west) could be impacted by the treated wastewater and is included in this pathway.
[75] To reduce the public health risk, any stream or drain potentially impacted by the treated wastewater plume would be excluded from a customary or commercial gathering operation. The mechanism for this would need to be codified.

#	Exposure Pathways - Option 3: L+R (a) inland	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
15	main discharge to land then shallow groundwater then streams and drains with current or potential commercial gathering of shellfish or fish (incl eels) from streams and drains	Moderate	Unlikely	Medium
16	main discharge to land then direct[76] as surface runoff to streams and drains with secondary contact recreation in streams within the application area	Minor	Rare	Low
17	transfer pipe breakage[77] discharge of treated WW to surface water[78] where contact recreation occurs	Moderate	Rare	Low
18	transfer pipe breakage discharge of treated WW to shallow groundwater to bore used as domestic water supply[79]	Moderate	Rare	Low
19	transfer pipe breakage discharge of treated WW to land then surface water or shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as municipal or commercial water supply for horticulture or irrigation[80]	Moderate	Rare	Low
	Resultant Risk level for Option: (critical of all pathways)			**High**

[76] The land application areas will be designed, operated and maintained to ensure that surface runoff is minimised and that applied treated wastewater is discharge via land to to the shallow groundwater. Therefore this pathway is considered to be rare for all the exposure pathways associated with this discharge route.
[77] Pipe normally below ground, but pressure from pumping will result in high pressure release at the surface of the treated wastewater. Stream crossing will be below or as pipe bridges but will be above ground.
[78] The pipeline between the WWTP and the outfall crosses a number of minor tributaries with low flow and no major recreational areas. No swimming areas, so would be suitable for wading / playing and not swimming.
[79] It is assumed that any pipe break can be identified within 24 hour timeframe, and any impacted private bores would be identified and its use would be stopped. During the design phase, all water supply bores in the vicinity of the route will be identified and a log of the contact details of the water supplies by the scheme operator will be maintained during the life of the scheme to facilitate the public health response.
[80] A municipal or commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route. We assume that the municipal supply will include treatment which will reduce risk and any commercial operation can control subsequent supply of product to the public to minimise exposure.

Option 3: L+R (b) 97 % applied to a coastal land application site and a discharge to river in exceptional circumstances

#	Exposure Pathways - Option 3: L+R (b) coastal	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
1	main discharge[81] to land then shallow groundwater to bore used as domestic water supply[82]	Minor/moderate[83]	Rare[84]	Low
2	main discharge to land then shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as commercial water supply for horticulture or irrigation[85]	Moderate[86]	Rare[87]	Low
3	main discharge to air then spray drift[88] to neighbours[89] and inhaled	Moderate	Rare[90]	Low
4	main discharge to air then spray drift to neighbour's roof used to supply tank water for untreated domestic water supply	Moderate	None[91]	None
5	main discharge to air then spray drift to public recreating on land within land application area[92]	Moderate	Rare	Low
6	main discharge to land[93] then shallow groundwater to Coastal Lakes with contact recreation[94] in lakes	Insignificant/minor	Likely	Medium/high

[81] Biological treatment with clarification and UV, residual level of pathogens remain
[82] All bores within scheme are replaced with public water supply so only bores outside of scheme are potentially affected.
[83] Given level of treatment through WWTP and land and at least 600m of distance through aquifer, large removal of pathogens expected. Increase in nitrate concentrations as a result of the treated wastewater application is expected to be less than NZDWS 2018 MAV. Note that groundwater concentration may already be elevated.
[84] Domestic water supply bores have small drawdown zone of 10m and hence risk of incorporating groundwater affected by treated wastewater plume is low.
[85] A commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route.
[86] Given level of treatment through WWTP and land and at least 600m of distance through aquifer, large removal of pathogens expected. Given the larger volume of use and the wider number of people potentially exposed to the pathogens, the scale of the effect is considered larger than the domestic water supply bore.
[87] As part of the scheme all bores in the application area will be sealed to prevent this pathway, however some bores may be missed and hence there is a risk that this route may remain open.
[88] Solid State spray into trees with wind control with buffer zones included around the schemes.
[89] Distance to neighbour is unknown but minimal neighbours around this site.
[90] Mitigation measures render spray drift of aerosol to neighbours unlikely. Minimal houses around the coastal land application area
[91] Assume that all potentially affected houses will be provided with alternative domestic water supply
[92] Assume that public will be kept from the active spray areas and hence any exposure to spray drift will be subsequent to adequate mitigation measures
[93] Most of the treated wastewater will be applied downgradient of the Coastal Lakes and only a minor fraction will be applied upgradient.
[94] Lakes are not suitable for primary recreation as shallow, muddy and macrophyte dominated, but are used for duck shooting and could be used for kayaking and other secondary contact recreation

#	Exposure Pathways - Option 3: L+R (b) coastal	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
7	main discharge to land then shallow groundwater to Coastal lakes with recreational gathering of watercress, shellfish, fish (incl eels) from lakes	Insignificant/minor	Possible	Low/Medium
8	main discharge to land then shallow groundwater to Coastal lakes with customary gathering of watercress, shellfish, fish (incl eels) from lakes	Insignificant/minor	Possible	Low/medium
9	main discharge to land then shallow groundwater to Coastal lakes with commercial gathering of watercress, shellfish, fish (incl eels) from lakes	Insignificant/minor	Possible	Low/medium
10	**main discharge to land then shallow groundwater to coast with contact recreation[95] on beach**	**Insignificant[96]**	**Almost certain**	**High**
11	**main discharge to land then shallow groundwater to coast with recreational gathering of shellfish[97] on beach**	**Minor**	**Almost certain**	**High**
12	**main discharge to land then shallow groundwater to coast with commercial gathering of shellfish on beach**	**Minor**	**Almost certain**	**High**
13	main discharge to land then shallow groundwater then streams and drains with contact recreation in streams[98]	Minor	Possible[99]	Medium
14	**main discharge to land then shallow groundwater then streams and drains with recreational gathering of watercress, shellfish, fish (incl eels) from streams and drains**	**Moderate**	**Possible**	**High**

[95] Beaches near Himatangi Beach and Foxton Beach are well used public beaches. The shallow groundwater potentially containing treated wastewater will enter the beach and children could interact directly with this affected groundwater, albeit following significant treatment through the land and at significant dilutions.
[96] Travel time between the application area and the beach is a minimum of 1 year and probably more likely to be 5-10 years. This will allow considerable reduction in pathogens and reduction in risk of illness.
[97] There are shellfish beds on the beach adjacent to the potential land application site from which the public can gather shellfish
[98] Assume that primary contact not feasible in streams and drains due to depth and nature of streams
[99] Access to the >3000ha application area will be controlled and hence incidence of collection from streams and drains will be reduced. All streams downstream of the application (to the west) could be impacted by the treated wastewater and is included in this pathway.

#	Exposure Pathways - Option 3: L+R (b) coastal	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
15	main discharge to land then shallow groundwater then streams and drains with customary gathering of watercress, shellfish, fish (incl eels) from streams and drains	Moderate	Unlikely[100]	Medium
16	main discharge to land then shallow groundwater then streams and drains with current or potential future commercial food gathering of watercress, shellfish, fish (incl eels) from streams and drains	Moderate	Unlikely	Medium
17	main discharge to land then direct[101] to streams and drains with secondary contact recreation in streams	Insignificant	Rare	Low
18	transfer pipe breakage[102] discharge of treated WW to surface water[103] where contact recreation occurs	Moderate	Rare	Low
19	transfer pipe breakage discharge of treated WW to shallow groundwater to bore used as domestic water supply[104]	Moderate	Rare	Low
20	transfer pipe breakage discharge of treated WW to land then surface water or shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as municipal or commercial water supply for horticulture or irrigation[105]	Moderate	Rare	Low

[100] To reduce the public health risk, any stream or drain potentially impacted by the treated wastewater plume would be excluded from a customary or commercial gathering operation. The mechanism for this would need to be codified.
[101] The land application areas will be designed, operated and maintained to ensure that surface runoff is minimised and that applied treated wastewater is discharge via land to the shallow groundwater. Therefore this pathway is considered to be rare for all the exposure pathways associated with this discharge route.
[102] Pipe normally below ground, but pressure from pumping will result in high pressure release at the surface of the treated wastewater. Stream crossing will be below or as pipe bridges but will be above ground.
[103] The pipeline between the WWTP and the outfall crosses a number of minor tributaries with low flow and no major recreational areas. No swimming areas, so would be suitable for wading / playing and not swimming.
[104] It is assumed that any pipe break can be identified within 24 hour timeframe, and any impacted private bores would be identified and its use would be stopped. During the design phase, all water supply bores in the vicinity of the route will be identified and a log of the contact details of the water supplies by the scheme operator will be maintained during the life of the scheme to facilitate the public health response.
[105] A municipal or commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route. We assume that the municipal supply will include treatment which will reduce risk and any commercial operation can control subsequent supply of product to the public to minimise exposure.

#	Exposure Pathways - Option 3: L+R (b) coastal	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
	Resultant Risk level for Option: (critical of all pathways)			**High**

Option 4: L + R (d) 45% or 55%[106] applied to an inland land application site and a river discharge for the remainder of the time

#	Exposure Pathways - Option 4: L + R (d) inland	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
1	main discharge[107] to land then shallow groundwater to bore used as domestic water supply[108]	Insignificant[109]	Possible	Low
2	main discharge to land then shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as commercial water supply for horticulture or irrigation[110]	Moderate[111]	Rare[112]	Low
3	main discharge to air then spray drift[113] to neighbours within application area and inhaled	Moderate	Rare[114]	Low
4	main discharge to air then spray drift to neighbour's roof used to supply tank water for untreated domestic water supply	Moderate	None[115]	None
5	main discharge to air then spray drift to public recreating on land within land application area[116]	Moderate	Rare	Low
6	main discharge to land then shallow groundwater to Manawatu River with contact recreation in river above Opiki	Minor	Possible	Medium

[106] For this assessment the 45% and 55% options are considered to be equivalent and have the same scoring
[107] Biological treatment with clarification and UV, residual level of pathogens remain
[108] All bores within scheme are replaced or appropriately managed with public water supply so only bores outside of scheme are potentially affected and assessed here. Domestic water supply bores have small drawdown zone of 10m and hence risk of incorporating groundwater affected by treated wastewater plume is insignificant.
[109] Given level of treatment and at least 600m of distance through aquifer, large removal of pathogens expected. Increase in nitrate concentrations as a result of the treated wastewater application is expected to be less than NZDWS 2018 MAV. Note that groundwater concentration may already be elevated.
[110] A commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route.
[111] Given level of treatment and at least 100m of distance through aquifer, large removal of pathogens expected. Given the larger volume of use and the wider number of people potentially exposed to the pathogens, the scale of the effect is considered larger than the domestic water supply bore.
[112] As part of the scheme all bores in the application area will be sealed to prevent this pathway, however some bores may be missed and hence there is a risk that this route may remain open.
[113] Centre pivot with wind control with buffer zones and wind planting included around the schemes.
[114] Mitigation measures render spray drift of aerosol to neighbours rare
[115] Assume that all potentially affected houses will be provided with alternative domestic water supply
[116] Assume that public will be kept from the active spray areas and hence any exposure to spray drift will be subsequent to adequate mitigation measures

#	Exposure Pathways - Option 4: L + R (d) inland	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
7	**main discharge to land then shallow groundwater to Manawatu River with contact recreation in river downstream below Opiki**	**Moderate**	**Likely**[117]	**High**
8	main discharge to land then shallow groundwater to Manawatu River with water take for current or potential future untreated domestic drinking water from river downstream	Insignificant/minor	Rare	Low
9	main discharge to land then shallow groundwater to Manawatu River with recreational gathering of water cress from river downstream	Insignificant/minor	Unlikely	Low
10	main discharge to land then shallow groundwater to Manawatu River with recreational food gathering of shellfish, fish (incl eels) from river downstream	Insignificant/minor[118]	Likely	Medium/high
11	main discharge to land then shallow groundwater to Manawatu River with current or potential commercial food gathering of shellfish, fish (incl eels) from river downstream	Insignificant/minor	Likely	Medium/high
12	main discharge to land then shallow groundwater then streams and drains with contact recreation in streams[119]	Insignificant	Possible[120]	Low
13	**main discharge to land then shallow groundwater then streams and drains with recreational gathering of water cress, shellfish or fish (incl eels) from streams and drains**	**Moderate**	**Possible**	**High**

[117] The treated wastewater is removed from the river during low flow and hence by the time the discharge reaches the river below Opiki it is either highly dilute which will reduce the public health risk or is not present when recreational activities take place which would be in lower flow conditions.
[118] Scheme is not being operated to optimise land treatment, therefore cannot reduce scale of public health effect to reflect probable increased treatment through land resulting from application during low river flow.
[119] Assume that primary contact not feasible in streams and drains due to depth and nature of streams
[120] Access to the 1700ha application area will be controlled and hence incidence of collection from streams and drains will be reduced. All streams downstream of the application (to the west) could be impacted by the treated wastewater and is included in this pathway.

#	Exposure Pathways - Option 4: L + R (d) inland	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
14	main discharge to land then shallow groundwater then streams and drains with customary gathering of watercress, shellfish or fish (incl eels) from streams and drains	Minor	Unlikely[121]	Low
15	main discharge to land then shallow groundwater then streams and drains with current or potential commercial gathering of shellfish or fish (incl eels) from streams and drains	Minor	Unlikely	Low
16	main discharge to land then direct[122] as surface runoff to streams and drains with secondary contact recreation in streams within the application area	Minor	Rare	Low
17	transfer pipe breakage[123] discharge of treated WW to surface water[124] where contact recreation occurs	Moderate	Rare	Low
18	transfer pipe breakage discharge of treated WW to shallow groundwater to bore used as domestic water supply[125]	Moderate	Rare	Low
19	transfer pipe breakage discharge of treated WW to land then surface water or shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as municipal or commercial water supply for horticulture or irrigation[126]	Moderate	Rare	Low

[121] To reduce the public health risk, any stream or drain potentially impacted by the treated wastewater plume would be excluded from a customary or commercial gathering operation. The mechanism for this would need to be codified.
[122] The land application areas will be designed, operated and maintained to ensure that surface runoff is minimised and that applied treated wastewater is discharge via land to to the shallow groundwater. Therefore this pathway is considered to be rare for all the exposure pathways associated with this discharge route.
[123] Pipe normally below ground, but pressure from pumping will result in high pressure release at the surface of the treated wastewater. Stream crossing will be below or as pipe bridges but will be above ground.
[124] The pipeline between the WWTP and the outfall crosses a number of minor tributaries with low flow and no major recreational areas. No swimming areas, so would be suitable for wading / playing and not swimming.
[125] It is assumed that any pipe break can be identified within 24 hour timeframe, and any impacted private bores would be identified and its use would be stopped. During the design phase, all water supply bores in the vicinity of the route will be identified and a log of the contact details of the water supplies by the scheme operator will be maintained during the life of the scheme to facilitate the public health response.
[126] A municipal or commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route. We assume that the municipal supply will include treatment which will reduce risk and any commercial operation can control subsequent supply of product to the public to minimise exposure.

#	Exposure Pathways - Option 4: L + R (d) inland	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
20	main discharge[127] direct to Manawatu River at WWTP with contact recreation in river downstream above Opiki	Moderate	Unlikely[128]	Medium
21	**main discharge direct to Manawatu River at WWTP with contact recreation in river downstream below Opiki**	**Moderate**	**Possible**	**High**
22	main discharge direct to Manawatu River at WWTP with water take for untreated domestic drinking water from river downstream	Moderate[129]	Rare/None	Low/None
23	main discharge direct to Manawatu River at WWTP with water take for potential future untreated domestic drinking water from river downstream	Moderate	Rare/None[130]	Low/None
24	main discharge direct to Manawatu River at WWTP with recreational gathering of water cress from river downstream	Moderate	Unlikely	Medium
25	**main discharge direct to Manawatu River at WWTP with recreational gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**
26	**main discharge direct to Manawatu River at WWTP with current or potential customary or commercial food gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**
27	main discharge to wetland before discharge to Manawatu River - recreational gathering of water cress from wetland	Insignificant/minor[131]	Rare/None[132]	Low/None

[127] Biological treatment with clarification and UV, residual level of pathogens remain
[128] During lower flow discharge will be removed from the river to land. Discharge direct to the river just below the WWTP is only during higher river flows, when dilution is higher and contact recreation is less prevalent.
[129] There will significant dilution in the river by the point of any take given the discharge scenario which would reduce the risk, however, there is not as high a level of treatment as the river only option. Risk of illness from the treated wastewater will need to be assessed in more detail. With distance downstream, dilution increases and hence risk of illness reduces.
[130] There are no current consented water takes from the Manawatu River. However, there may be takes under the permitted activity rules.
[131] If birds gather on the wetland then some potential for pathogens carried by birds to be deposited in the wetlands. However current design is for fully vegetated wetlands which are less attractive to birds which reduces this risk.
[132] Public access to the wetland will be restricted as it is part of the WWTP.

#	Exposure Pathways - Option 4: L + R (d) inland	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
28	main discharge to wetland before discharge to Manawatu River - recreational gathering of shellfish, fish or eels from wetland	Insignificant/minor	Rare/None	Low/None
	Resultant Risk level for Option: (critical of all pathways)			**High**

Option 4: L + R (e) 45% or 55%[133] applied to a coastal land application site and a river discharge for the remainder of the time

#	Exposure Pathways - Option 4: L + R (e) coastal	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
1	main discharge[134] to land then shallow groundwater to bore used as domestic water supply[135]	Minor/moderate[136]	Rare[137]	Low
2	main discharge to land then shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as commercial water supply for horticulture or irrigation[138]	Moderate[139]	Rare[140]	Low
3	main discharge to air then spray drift[141] to neighbours[142] and inhaled	Moderate	Rare[143]	Low
4	main discharge to air then spray drift to neighbour's roof used to supply tank water for untreated domestic water supply	Moderate	None[144]	None
5	main discharge to air then spray drift to public recreating on land within land application area[145]	Moderate	Rare	Low

133 For this assessment the 45% and 55% options are considered to be equivalent and have the same scoring
134 Biological treatment with clarification and UV, residual level of pathogens remain
135 All bores within scheme are replaced with public water supply so only bores outside of scheme are potentially affected.
136 Given level of treatment through WWTP and land and at least 600m of distance through aquifer, large removal of pathogens expected. Increase in nitrate concentrations as a result of the treated wastewater application is expected to be less than NZDWS 2018 MAV. Note that groundwater concentration may already be elevated.
137 Domestic water supply bores have small drawdown zone of 10m and hence risk of incorporating groundwater affected by treated wastewater plume is low.
138 A commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route.
139 Given level of treatment and at least 600m of distance through aquifer, large removal of pathogens expected. Given the larger volume of use and the wider number of people potentially exposed to the pathogens, the scale of the effect is considered larger than the domestic water supply bore.
140 As part of the scheme all bores in the application area will be sealed to prevent this pathway, however some bores may be missed and hence there is a risk that this route may remain open.
141 Solid State spray into trees with wind control with buffer zones included around the schemes.
142 Distance to neighbour is unknown but minimal neighbours around this site.
143 Mitigation measures render spray drift of aerosol to neighbours unlikely. Minimal houses around the coastal land application area
144 Assume that all potentially affected houses will be provided with alternative domestic water supply
145 Assume that public will be kept from the active spray areas and hence any exposure to spray drift will be subsequent to adequate mitigation measures

#	Exposure Pathways - Option 4: L + R (e) coastal	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
6	main discharge to land[146] then shallow groundwater to Coastal Lakes with contact recreation[147] in lakes	Insignificant/minor	Likely	Medium/high
7	main discharge to land then shallow groundwater to Coastal lakes with recreational gathering of watercress, shellfish, fish (incl eels) from lakes	Insignificant/minor	Possible	Low/Medium
8	main discharge to land then shallow groundwater to Coastal lakes with customary gathering of watercress, shellfish, fish (incl eels) from lakes	Insignificant/minor	Possible	Low/medium
9	main discharge to land then shallow groundwater to Coastal lakes with commercial gathering of watercress, shellfish, fish (incl eels) from lakes	Insignificant/minor	Possible	Low/medium
10	**main discharge to land then shallow groundwater to coast with contact recreation[148] on beach**	**Minor[149]**	**Almost certain**	**High**
11	**main discharge to land then shallow groundwater to coast with recreational gathering of shellfish[150] on beach**	**Minor**	**Almost certain**	**High**
12	**main discharge to land then shallow groundwater to coast with commercial gathering of shellfish on beach**	**Minor**	**Almost certain**	**High**
13	main discharge to land then shallow groundwater then streams and drains with contact recreation in streams	Minor	Unlikely[151]	Low

[146] Most of the treated wastewater will be applied downgradient of the Coastal Lakes and only a minor fraction will be applied upgradient.
[147] Lakes are not suitable for primary recreation as shallow, muddy and macrophyte dominated, but are used for duck shooting and could be used for kayaking and other secondary contact recreation
[148] Beaches near Himatangi Beach and Foxton Beach are well used public beaches. The shallow groundwater potentially containing treated wastewater will enter the beach and children could interact directly with this affected groundwater, albeit following significant treatment through the land and at significant dilutions.
[149] Travel time between the application area and the beach is a minimum of 1 year and probably more likely to be 5-10 years. This will allow considerable reduction in pathogens and reduction in risk of illness.
[150] There are shellfish beds on the beach adjacent to the potential land application site from which the public can gather shellfish
[151] Due to depth and nature of streams, contact recreation is unlikely

#	Exposure Pathways - Option 4: L + R (e) coastal	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
14	**main discharge to land then shallow groundwater then streams and drains with recreational gathering of watercress, shellfish, fish (incl eels) from streams and drains**	**Moderate**	**Possible**[152]	**High**
15	main discharge to land then shallow groundwater then streams and drains with customary gathering of watercress, shellfish, fish (incl eels) from streams and drains	Moderate	Unlikely[153]	Medium
16	main discharge to land then shallow groundwater then streams and drains with current or potential future commercial food gathering of watercress, shellfish, fish (incl eels) from streams and drains	Moderate	Unlikely	Medium
17	main discharge to land then direct[154] to streams and drains with secondary contact recreation in streams	Insignificant	Rare	Low
18	transfer pipe breakage[155] discharge of treated WW to surface water[156] where contact recreation occurs	Moderate	Rare	Low
19	transfer pipe breakage discharge of treated WW to shallow groundwater to bore used as domestic water supply[157]	Moderate	Rare	Low

[152] Access to the 1700ha application area will be controlled and hence incidence of collection from streams and drains will be reduced. All streams downstream of the application (to the west) could be impacted by the treated wastewater and is included in this pathway.
[153] To reduce the public health risk, any stream or drain potentially impacted by the treated wastewater plume would be excluded from a customary or commercial gathering operation. The mechanism for this would need to be codified.
[154] The land application areas will be designed, operated and maintained to ensure that surface runoff is minimised and that applied treated wastewater is discharge via land to the shallow groundwater. Therefore this pathway is considered to be rare for all the exposure pathways associated with this discharge route.
[155] Pipe normally below ground, but pressure from pumping will result in high pressure release at the surface of the treated wastewater. Stream crossing will be below or as pipe bridges but will be above ground.
[156] The pipeline between the WWTP and the outfall crosses a number of minor tributaries with low flow and no major recreational areas. No swimming areas, so would be suitable for wading / playing and not swimming.
[157] It is assumed that any pipe break can be identified within 24 hour timeframe, and any impacted private bores would be identified and its use would be stopped. During the design phase, all water supply bores in the vicinity of the route will be identified and a log of the contact details of the water supplies by the scheme operator will be maintained during the life of the scheme to facilitate the public health response.

#	Exposure Pathways - Option 4: L + R (e) coastal	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
20	transfer pipe breakage discharge of treated WW to land then surface water or shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as municipal or commercial water supply for horticulture or irrigation[158]	Moderate	Rare	Low
21	**main discharge[159] direct to Manawatu River at WWTP with contact recreation in river downstream above Opiki**	**Moderate**	**Possible[160]**	**High**
22	**main discharge direct to Manawatu River at WWTP with contact recreation in river downstream below Opiki**	**Moderate**	**Likely**	**High**
23	main discharge direct to Manawatu River at WWTP with water take for untreated domestic drinking water from river downstream	Moderate[161]	Rare/None	Low/None
24	main discharge direct to Manawatu River at WWTP with water take for potential future untreated domestic drinking water from river downstream	Moderate	Rare/unlikely	Low/medium
25	main discharge direct to Manawatu River at WWTP with recreational gathering of water cress from river downstream	Moderate	Unlikely	Medium
26	**main discharge direct to Manawatu River at WWTP with recreational gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**

[158] A municipal or commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route. We assume that the municipal supply will include treatment which will reduce risk and any commercial operation can control subsequent supply of product to the public to minimise exposure.
[159] Biological treatment with clarification and UV, residual level of pathogens remain
[160] During lower flow discharge will be removed from the river to land. Discharge direct to the river just below the WWTP is only during higher river flows, when dilution is higher and contact recreation is less prevalent.
[161] There will significant dilution in the river by the point of any take given the discharge scenario which would reduce the risk, however, there is not as high a level of treatment as the river only option.

#	Exposure Pathways - Option 4: L + R (e) coastal	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
27	**main discharge direct to Manawatu River at WWTP with current or potential customary or commercial food gathering of shellfish, fish (incl eels) from river downstream**	**Moderate**	**Likely**	**High**
28	main discharge to wetland before discharge to Manawatu River - recreational gathering of water cress from wetland	Insignificant/minor[162]	Rare/None[163]	Low/None
29	main discharge to wetland before discharge to Manawatu River - recreational gathering of shellfish, fish or eels from wetland	Insignificant/minor	Rare/None	Low/None
	Resultant Risk level for Option: (critical of all pathways)			**High**

[162] If birds gather on the wetland then some potential for pathogens carried by birds to be deposited in the wetlands. However current design is for fully vegetated wetlands which are less attractive to birds which reduces this risk.
[163] Public access to the wetland will be restricted as it is part of the WWTP.

Option 6 Ocean: Ocean discharge, with a small % to land (half of the average dry flow in November to April)

#	Exposure Pathways - Option 6 Ocean with land	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
1	**main discharge[164] through outfall[165] to beach contact rec**	**Moderate**	**Possible**	**High**
2	**main discharge through outfall to recreational fishing/shellfish gathering**	**Moderate**	**Possible**	**High**
3	**main discharge through outfall to potential future commercial aquaculture**	**Moderate**	**Possible**	**High**
4	main discharge to land then shallow groundwater to bore used as domestic water supply[166]	Minor/moderate[167]	Rare[168]	Low
5	main discharge to land then shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as commercial water supply for horticulture or irrigation[169]	Moderate[170]	Rare[171]	Low
6	main discharge to air then spray drift[172] to neighbours[173] and inhaled	Moderate	Rare[174]	Low
7	main discharge to air then spray drift to neighbour's roof used to supply tank water for untreated domestic water supply	Moderate	None[175]	None

[164] Biological treatment with clarification and UV, residual level of pathogens remain
O[165] outfall is 2km from coast. This results in significant dilutions at beach, and plume will generally not go to beach but will travel offshore
[166] All bores within scheme are replaced with public water supply so only bores outside of scheme are potentially affected.
[167] Given level of treatment through WWTP and land and at least 600m of distance through aquifer, large removal of pathogens expected. Increase in nitrate concentrations as a result of the treated wastewater application is expected to be less than NZDWS 2018 MAV. Note that groundwater concentration may already be elevated.
[168] Domestic water supply bores have small drawdown zone of 10m and hence risk of incorporating groundwater affected by treated wastewater plume is low.
[169] A commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route.
[170] Given level of treatment and at least 600m of distance through aquifer, large removal of pathogens expected. Given the larger volume of use and the wider number of people potentially exposed to the pathogens, the scale of the effect is considered larger than the domestic water supply bore.
[171] As part of the scheme all bores in the application area will be sealed to prevent this pathway, however some bores may be missed and hence there is a risk that this route may remain open.
[172] Solid State spray into trees with wind control with buffer zones included around the schemes.
[173] Distance to neighbour is unknown but minimal neighbours around this site.
[174] Mitigation measures render spray drift of aerosol to neighbours unlikely. Minimal houses around the coastal land application area
[175] Assume that all potentially affected houses will be provided with alternative domestic water supply

#	Exposure Pathways - Option 6 Ocean with land	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
8	main discharge to air then spray drift to public recreating on land within land application area[176]	Moderate	Rare	Low
9	main discharge to land[177] then shallow groundwater to Coastal Lakes[178] with secondary contact recreation[179] in lakes	Insignificant/minor	Rare/None	None/Low
10	**main discharge to land then shallow groundwater to coast with primary contact recreation[180] on beach**	**Moderate[181]**	**Likely**	**High**
11	**main discharge to land then shallow groundwater to coast with recreational gathering of shellfish[182] on beach**	**Moderate**	**Likely**	**High**
12	**main discharge to land then shallow groundwater to coast with customary or commercial gathering of shellfish on beach**	**Moderate**	**Likely**	**High**
13	main discharge to land then shallow groundwater then streams and drains[183] with contact recreation in streams[184]	Minor	Unlikely[185]	Low

[176] Assume that public will be kept from the active spray areas and hence any exposure to spray drift will be subsequent to adequate mitigation measures
[177] Most of the treated wastewater will be applied downgradient of the Coastal Lakes and only a minor fraction will be applied upgradient.
[178] Application area is downgradient of lakes and hence the plume is unlikely to travel towards them especially as application is restricted to summer months and restricted to half of average dry weather.
[179] Lakes are not suitable for primary recreation as shallow, muddy and macrophyte dominated, but are used for duck shooting and could be used for kayaking and other secondary contact recreation
[180] Beaches near Himatangi Beach and Foxton Beach are well used public beaches. The shallow groundwater potentially containing treated wastewater will enter the beach and children could interact directly with this affected groundwater, albeit following significant treatment through the land and at significant dilutions.
[181] Travel time between the application area and the beach is a minimum of 1 year and probably more likely to be 5-10 years. This will allow considerable reduction in pathogens and reduction in risk of illness.
[182] There are shellfish beds on the beach adjacent to the potential land application site from which the public can gather shellfish
[183] Application area restricted to sandy dunes and is not in the coastal hinterland behind the sand dunes where most of the streams and drains are located. There is still a stream that runs along the northern edge of the application area. Given that application restricted to summer months, and reduced flows, potential for discharge to streams is reduced from year round operation.
[184] Assume that primary contact not feasible in streams and drains due to depth and nature of streams
[185] Application area is relatively small and access to potentially affected streams and drains can be controlled such that exposure is unlikely.

#	Exposure Pathways - Option 6 Ocean with land	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
14	main discharge to land then shallow groundwater then streams and drains with recreational gathering of watercress, shellfish, fish (incl eels) from streams and drains	Minor	Unlikely	Low
15	main discharge to land then shallow groundwater then streams and drains with customary gathering of watercress, shellfish, fish (incl eels) from streams and drains	Minor	Unlikely[186]	Low
16	main discharge to land then shallow groundwater then streams and drains with current or potential future commercial food gathering of watercress, shellfish, fish (incl eels) from streams and drains	Minor	Unlikely	Low
17	main discharge to land then direct[187] to streams and drains with secondary contact recreation in streams	Insignificant	Rare	Low
18	transfer pipe breakage[188] discharge of treated WW to surface water[189] where contact recreation occurs	Moderate	Rare	Low
19	transfer pipe breakage discharge of treated WW to shallow groundwater to bore used as domestic water supply[190]	Moderate	Rare	Low
20	transfer pipe breakage discharge of treated WW to land then surface water or shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to	Moderate	Rare	Low

[186] To reduce the public health risk, any stream or drain potentially impacted by the treated wastewater plume would be excluded from a customary or commercial gathering operation. The mechanism for this would need to be codified. The area potentially affected is smaller than other options.
[187] The land application areas will be designed, operated and maintained to ensure that surface runoff is minimised and that applied treated wastewater is discharge via land to the shallow groundwater. Therefore this pathway is considered to be rare for all the exposure pathways associated with this discharge route.
[188] Pipe normally below ground, but pressure from pumping will result in high pressure release at the surface of the treated wastewater. Stream crossing will be below or as pipe bridges but will be above ground.
[189] The pipeline between the WWTP and the outfall crosses a number of minor tributaries with low flow and no major recreational areas. No swimming areas, so would be suitable for wading / playing and not swimming.
[190] It is assumed that any pipe break can be identified within 24 hour timeframe, and any impacted private bores would be identified and its use would be stopped. During the design phase, all water supply bores in the vicinity of the route will be identified and a log of the contact details of the water supplies by the scheme operator will be maintained during the life of the scheme to facilitate the public health response.

#	Exposure Pathways - Option 6 Ocean with land	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
	bore used as municipal or commercial water supply for horticulture or irrigation[191]			
	Resultant Risk level for Option: (critical of all pathways)			**High**

[191] A municipal or commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route. We assume that the municipal supply will include treatment which will reduce risk and any commercial operation can control subsequent supply of product to the public to minimise exposure.

Option 6 Ocean: Ocean discharge

#	Exposure Pathways - Option 6 Ocean	Scale of Public Health Risk	Frequency of Exposure	Qualitative Risk Rating
1	**main discharge[192] through outfall[193] to beach contact rec**	**Moderate**	**Possible**	**High**
2	**main discharge through outfall to recreational fishing/shellfish gathering**	**Moderate**	**Possible**	**High**
3	**main discharge through outfall to potential future commercial aquaculture**	**Moderate**	**Possible**	**High**
4	transfer pipe breakage[194] discharge of treated WW to surface water[195] where contact recreation occurs	Moderate	Rare	Low
5	transfer pipe breakage discharge of treated WW to shallow groundwater to bore used as domestic water supply[196]	Moderate	Rare	Low
6	transfer pipe breakage discharge of treated WW to land then surface water or shallow groundwater then intermediate groundwater via inadequately sealed bore in application area to bore used as municipal or commercial water supply for horticulture or irrigation[197]	Moderate	Rare	Low
	Resultant Risk level for Option: (critical of all pathways)			**High**

[192] Biological treatment with clarification and UV, residual level of pathogens remain
[193] outfall is 2km from coast. This results in significant dilutions at beach, and plume will generally not go to beach but will travel offshore
[194] Pipe normally below ground, but pressure from pumping will result in high pressure release at the surface of the treated wastewater. Stream crossing will be below or as pipe bridges but will be above ground.
[195] The pipeline between the WWTP and the outfall crosses a number of minor tributaries with low flow and no major recreational areas. No swimming areas, so would be suitable for wading / playing and not swimming.
[196] It is assumed that any pipe break can be identified within 24 hour timeframe, and any impacted private bores would be identified and its use would be stopped. During the design phase, all water supply bores in the vicinity of the route will be identified and a log of the contact details of the water supplies by the scheme operator will be maintained during the life of the scheme to facilitate the public health response.
[197] A municipal or commercial water supply bore will be for a large water take with a larger drawdown area and hence will potentially be impacted by a wider area of impact. This will increase the risk that the bore could be impacted by a plume from this route. We assume that the municipal supply will include treatment which will reduce risk and any commercial operation can control subsequent supply of product to the public to minimise exposure.

1 Cultural Comparative Assessment of Short-listed options

1.1 Introduction

This report sets out the Rangitāne o Manawatū cultural comparative assessment of the short-listed options for the Palmerston North Wastewater BPO Project ("Nature Calls").

The report was prepared by:

- Rangitāne o Manawatū representatives over a number of hui and wananga.

1.2 Criterion and Scoring Approach

Criterion	Description	1	2	3	4	5
Rangitāne Cultural Values	Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Rangitāne o Manawatū, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga	Destruction of Rangitāne culture, connections and kaitiakitanga. Critical effect on Rangitāne o Manawatū	Significant effect or impact on all aspects of Rangitāne Mana, Toanga, Atua and natural resources	Major impact on all aspects of Rangitāne significant sites and natural resources	Minimal impact on Rangitāne significant sites and natural resources	Minimal to no effect on Rangitāne o Manawatū

1.3 Approach to the Assessment

The assessment was undertaken by the Rangitāne representatives. Rangitāne o Manawatū also invited neighbouring Iwi to a hui to go through the options as well. This hui was attended by representatives from Ngati Apa, Muaupoko and Ngati Kauwhata. Throughout the hui impacts on key cultural parameters were identified and discussed. However to be clear this paper does not seek to speak on their behalf or is their official response. They have their own mana and speak for themselves. The key parameters identified were;

Rangitāne O Manawatū Values

Mana Whenua

1. Will the activity uphold ROM mana?

Taonga

2. Does the activity impact our taonga and significant cultural sites in a negative way?

Mauri

3. Does the activity negatively impact mauri in our rohe?

Wairua

4. If there are effects from an activity will they negatively impact whanau ora, health and well-being?

Rangitāne O Manawatū Whenua Landscapes

Manawatū River

5. Is the activity impacting or impeding our kaitiakitanga over our taonga the River and its role to nourish our rohe and people?

Wetlands

6. Is there a negative impact on our wetlands?

Coast

7. Is the activity negatively impacting on the (Hauora) cultural health of our coastlines?

Dunes

8. Will the sand dune landforms be disrupted?

Mountains

9. Will the activity impact on our sacred peaks?

Rangitāne O Manawatu atua

Ranganui

10. Is Ranganui being respected?

Papatuanuku

11. Is Papatuanuku being cared for?

Tangaroa

12. Is Tangaroa still connected and in balance?

Haumia-tiketike
13. Is *Haumia-tiketike* still productive?
Rongomatane
14. Is *Rongomatane still cared for?*

Nga Uri o Rangitāne o Manawatu
15. Is this acceptable to our people.

1.4 Assumptions Applied in the Assessment

- We undertook our assessment with a focus on Rangitāne o Manawatū values only.
- Rangitāne o Manawatū maintains an initial position that any wastewater treatment process or system needs to start with ensuring investment is made on constantly improving the treatment methods to ensure that the wastewater eventually is at a “drinking water” standard. This is the preferred long-term “number 1” option. However, beyond this our scores are focussed on those options as currently presented to us.
- There is an assumption in the scores presented that the landuse of any future development will not result in a landuse which is more damaging to the current environment that the current landuse. Simply we are assuming that in the land application options that there is no intensification on landuse beyond the current landuse. We would also expect to be involved in landuse options as well.
- There is an assumption from Rangitāne o Manawatū that in those areas selected where significant cultural and historic sites exist that there will be no further negative impacts on those sites and that significant mitigation is envisaged to protect them further in partnership with us.

1.5 Assessment Table

The following table sets out the preliminary assessment of the options by the authors. This will be used as a starting point for discussion at the MCA workshop. The final MCA assessment and score may therefore differ from what is set out below.

Option	Variant	Assessment	Draft score
1: R2(b)	River discharge with enhanced treatment	The impacts on Rangitāne mana and one of the most significant taonga (river) is not acceptable. That option and activity has a negative flow on effect through all aspects of Rangitāne culture (fatally flawed).	1
	River discharge with enhanced treatment, and a small % to land	The impacts on Rangitāne mana and one of the most significant taonga (river) is not acceptable. That option and activity has a negative flow on effect through all aspects of Rangitāne culture (fatally flawed).	1
2: Dual R + L	Two river discharge points and a small % to land	The impacts on Rangitāne mana and one of the most significant taonga (river) is not acceptable. That option and activity has a negative flow on effect through all aspects of Rangitāne culture (fatally flawed).	1
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	Minimal effect or impact on Rangitāne o Manawatū. However there are still impacts on Rangitāne significant cultural and historic sites. Rangitāne mana less impacted if the site is maintained in the Manawatu.	4
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	Minor issues however there are still impacts on Rangitāne significant cultural and historic sites. Rangitāne are only open to one possible site which is near Tangimoana yet the impacts to coastal resources (wetlands and shellfish beds) are of significant concern.	3

Option	Variant	Assessment	Draft score
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	There are major effects or impacts on all aspects of Rangitāne mana, taonga, atua and natural resources compounding the effects on Nga Uri o Rangitāne.	2
	55 % applied to an inland land application site and a river discharge for the remainder of the time	The impacts on Rangitāne taonga and culture could be considered major. Concerns remain on the impact to significant cultural and historic sites requiring investigation. Rangitāne mana less impacted if site is maintained in the Manawatu.	3
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	There are significant impacts on all aspects of Rangitāne mana, taonga, atua and natural resources resulting in compounding effects to Nga Uri o Rangitāne.	2
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	Impact on all aspects of Rangitāne mana, taonga, atua and natural resources compounding to effect Nga uri o Rangitāne.	2
6: Ocean	Ocean discharge, with a small % to land	Significant to critical impacts on Rangitāne mana and culture as well as direct impacts to Nga Uri o Rangitāne who perceive this area as the last relatively untouched culturally important natural resource. (fatally flawed).	1
	Ocean discharge	Significant to critical impacts on Rangitāne mana and culture as well as direct impacts to Nga Uri o Rangitāne who perceive this area as the last relatively untouched culturally important natural resource. (fatally flawed).	1

Note: Option 5, which involved a mix of groundwater discharge and land application, was removed from the short list during the short list development phase of the project.

1 Resilience Comparative Assessment of Short-listed Options

1.1 Introduction

This report sets out the Resilience comparative assessment, as part of the Multi-Criteria Assessment (MCA) process of the short-listed options for the Palmerston North Wastewater BPO project (“Nature Calls”).

Resilience can be described as the ability of a system or organisation to respond to, or recover readily from, a crisis, disruptive process etc.

The report was prepared by:

- Overall Assessment of options
    - Rita Whitfield – Stantec Graduate Civil Engineer
    - Anna Bridgman – Stantec Group Manager/ Senior Civil Engineer
    - Peter Brown – Stantec Senior Civil Engineer
    - Jim Bradley – Stantec Technical Specialist
- Assessment of treatment element of options
    - Michael Tan – Stantec Process Engineer
    - Andrew Slaney – Stantec Senior Process Engineer
- Assessment of land treatment element of options
    - Luke Wilkinson – PDP Environmental Engineer
    - Aslan Perwick – PDP Groundwater Service Leader

1.2 Criterion and scoring approach

The overall scoring is as per the table below. Each of the two sub-criteria were scored with regards to how well the option aligned with that sub-criteria. The overall score is an average of these scores, with each sub-criteria given equal weighting. Average has been used rather than the lowest score as it is not believed that any one of these sub-criteria is the governing factor in the selection of the BPO.

Criterion	Description	1	2	3	4	5
Resilience	Degree to which the option is resilient to • natural hazards • climate change	Low degree of resilience	Low – Medium degree of resilience	Medium degree of resilience	Medium – High degree of resilience	High degree of resilience

1.3 Approach to the assessment

An option's draft score for resilience has been developed by first scoring each of the two resilience categories separately. An overall score was then given by averaging these two scores, with equal weighting being given to the two categories.

As land application sites, and pipeline route options, have only been identified at a high level the assessment of hazards for the options is at a more general level than particular identified for each location and option.

1.4 Resilience Categories

As set out in the MCA method report, the Resilience description is "Degree to which the option is resilient to natural hazards and climate change". Two categories have been identified for this criterion, namely natural hazards and climate change and adaptation. Operational resilience is covered in the Technology and Infrastructure Comparative Assessment of short listed options.

1.4.1 Natural Hazards

a) Risks of earthquakes damaging the infrastructure
b) Land movement and erosion affecting infrastructure
c) Flooding affecting infrastructure
d) Storm surge/tsunami affecting infrastructure

1.4.2 Climate Change and Adaptation

a) High intensity rainfall peaks affecting the infrastructure
b) Prolonged wet weather periods affecting the infrastructure
c) Prolonged dry periods affecting the infrastructure
d) Prolonged dry periods resulting in an increase of low flows in the Manawatū River flows, thereby requiring increased levels of treatment (phosphorous and nitrogen removal for greater periods of time)
e) Sea level rise possibly raising groundwater levels in the coastal sand country. Also, considerations associated with an ocean outfall scheme.

1.5 Assumptions applied in the assessment

- The design and operation of any option would take in to account a predetermined and prudent level of resilience for each of the resilience categories. This would be based on known matters at the time of design and installation.
- Options with at least dual, if not multiple, infrastructure components undertaking the same function would be viewed as more resilient than options relying on a single infrastructure component forming part of the scheme.
- All aspects at treatment plant score the same for natural hazards and climate change.
- There are varying degrees of seismic resilience within the existing treatment plant components. Any new infrastructure will be designed to Importance Level 4 (in accordance with the Building Code) for seismic resilience.
- It is recognised that all options have a vulnerability to flooding hazards as the treatment plant inlet works are recessed.
- Soil moisture modelling that has been completed to estimate the size of the scheme has taken the effects of climate change into account on the rainfall and Potential Evapotranspiration (PET).
- Flood risk to the schemes is assumed to be managed by using infrastructure designed to be removed from flood areas prior to a flood event, or by mobile irrigation systems (such as k-line) that can be completely removed from the flood risk area (in advance of a major flood). Assumed good management procedures will be in place.
- Climate change is not considered likely to affect crop growth conditions enough to cause the crop to be unable grow in the future. In the worst case, a different more suitable crop could be used.
- Consent conditions would be developed to ensure that during dry years, when more irrigation is required than usual, maximum loading limits for the land scheme will not be exceeded.
- A greater earthquake consequence is assumed for schemes with larger storage dams (that is the larger land application options).

- The risk of forest fire is present for the coastal forestry options. For this region, forest fire risk is rated as ‘average’ on a national scale – so it is not considered to be an area particularly prone to forest fires. Other fire risk management measures are assumed to be in place e.g. fire breaks, Emergency Response Plans.
- No perceived risk of climate change affecting crop growth/productivity.

1.6 Assessment table

The following table sets out the preliminary assessment of the options by the authors. This will be used as a starting point for discussion at the MCA workshop. The final MCA assessment and score may therefore differ from what is set out below. The natural hazards and climate change and adaptation categories as set out in Section 1.4 above have been assessed as a comparison of all these as they apply to each option.

Where there are assessment notes that are common to the variants of an option, these have been noted above the option variants.

Option	Variant	Natural Hazards	Natural Hazards Score	Climate Change & Adaptation	Climate Change Score	Draft Resilience MCA Score
1: R2(b)	Generic for both variants	- Scouring & realignment of river may affect outlet - Risk of lateral spreading with seismic activity - Improved resilience to flooding from current as the activated sludge is contained within tanks, which would be constructed to the building code regulations for flood levels, and therefore lesser impacted than current lagoons - Any new elements of treatment plant would be constructed to high level of seismic resilience		- Climate change physical effects on Manawatū River flow, resulting in longer low River flows, higher peaks, can be designed for - Potential extended dry periods may require additional phosphorus treatment and therefore higher operation costs - Prolonged wet weather results in bypass of more flow around membranes as it is constrained by membrane capacity		
	River discharge with enhanced treatment	-	4	-	4	4
	River discharge with enhanced treatment, and a small % to land	- Pipeline connections, pump stations at risk from seismic activity. No storage facility incorporated for this option. Events can be designed for, some remaining risk. - Pipeline route at limited risk of land movement and erosion. Route design will assist in minimising risk but cannot be removed - Scour risk at waterbody crossings - Flooding possible, some of the area is located within the floodplain. Some moveable k-line irrigators may be used in the floodplain. Good practice procedures required to be in place to ensure irrigation gear is not lost during large floods. Residual risk of a 'major' flood causing loss of irrigation land e.g. Manawatu River changes course. - Potential disease risk to crops. This could have both financial (reduced return), and environmental (reduced nutrient uptake / increased leaching) impacts. - Smaller land area needed than other land application options, could choose lower risk land	3	- Limited effects from high intensity rainfall peaks - Prolonged wet weather will have a limited effect as wastewater will go to river - Prolonged dry periods are likely to improve the efficiency of land application - Prolonged dry periods on Manawatu River will require more land discharge which may cause the system loading limits to be exceeded. Risk to be managed via appropriate development of consent conditions - Smaller land area needed than other land application options, could choose lower risk land	3	3
2: Dual R + L	Two river discharge points and a small % to land	- Potential earthquake damage to storage facility and/or distribution infrastructure (land scheme). This option has only a small storage facility (comparatively). Events can be designed for, some remaining risk. - Pipeline route at limited risk of land movement and erosion. Route design will assist in minimising risk but cannot be removed - Scour risk at waterbody crossings - Flooding possible, some of the area is located within the floodplain. Some moveable k-line irrigators may be used in the floodplain. Good practice procedures required to be in place to ensure irrigation gear is not lost during large floods. Residual risk of a 'major' flood causing loss of irrigation land e.g. Manawatu River changes course. - Potential disease risk to crops. This could have both financial (reduced return), and environmental (reduced nutrient uptake / increased leaching) impacts. - Smaller land area needed than other land application options, could choose lower risk land	4	- Climate change physical effects on Manawatū River flow, resulting in longer low River flows, higher peaks, can be designed for - Potential extended dry periods may require additional treatment or storage for river discharges - Limited effects from high intensity rainfall peaks - Prolonged wet weather will reduce the efficiency of the system and may cause increased leaching into groundwater - Prolonged dry periods are likely to improve the efficiency of land application - Smaller land area needed than other land application options, could choose lower risk land	3	3.5

<table>
<tr><th>Option</th><th>Variant</th><th>Natural Hazards</th><th>Natural Hazards Score</th><th>Climate Change & Adaptation</th><th>Climate Change Score</th><th>Draft Resilience MCA Score</th></tr>
<tr><td rowspan="3">3: L+R (a) & (b)</td><td>Generic for both variants</td><td>- Pipeline connections, pump stations, storage facility at risk from seismic. Events can be designed for, some remaining risk.
- Pipeline route at risk of land movement and erosion. Route design will assist in minimising risk but cannot be removed
- Scour risk at waterbody crossings
- Potential earthquake damage to storage facility and/or distribution infrastructure (land scheme). This option has only a small storage facility (comparatively). Events can be designed for, some remaining risk.
- Scouring & realignment of river may affect outlet
- Risk of lateral spreading with seismic activity
- Potential disease risk to crops. This could have both financial (reduced return), and environmental (reduced nutrient uptake / increased leaching) impacts.</td><td rowspan="2">3</td><td rowspan="2">- Limited effects from high intensity rainfall peaks, wastewater will go to the river for highest 97% of flows
- Prolonged wet weather will reduce the efficiency of the system and may cause increased leaching into groundwater. Prolonged wet weather may increase the risk of overflows from the storage lagoon, risk is managed with RI/contingency discharge
- Prolonged dry periods are likely to improve the efficiency of land application
- Climate change physical effects on Manawatū River flow, resulting in longer low River flows, higher peaks, can be designed for</td><td rowspan="2">3</td><td rowspan="2">3</td></tr>
<tr><td>97 % applied to an inland land application site and a discharge to river in exceptional circumstances (a)</td><td>- Flooding possible, some of the area is located within the floodplain. Some moveable k-line irrigators may be used in the floodplain. Good practice procedures required to be in place to ensure irrigation gear is not lost during large floods. Residual risk of a ‘major’ flood causing loss of irrigation land e.g. Manawatu River changes course.</td></tr>
<tr><td>97 % applied to a coastal land application site and a discharge to river in exceptional circumstances (b)</td><td>- Limited tsunami risk.
- Flooding possible but considered localised. Site is generally away from major watercourses.
- Potential large storm/winds risk e.g. fallen trees, areas of damage to forestry and/or irrigation gear.
- Potential Forest Fire Risk (note – the region is deemed 'Average' on a National Scale). If occurred: potential financial impact (e.g. loss of forest + irrigation gear – however assume that there would be insurance. Also potential environmental impacts associated with increased used of the River discharge until the land discharge system was restored.
- Pest control related risks</td><td>3</td><td>- Due to coastal location, some sea-level rise related risks, which effectively present as exacerbations of; storm-surge and/or flooding damage risk, erosion risk, groundwater table rise risks (potentially limiting useable area for forestry + reducing infiltration capacity of RI facility), although only expected to have a limited effect (over 35-year time period)
- Long term increase in forest fire risk possible (if climate tends drier/hotter).
- Though an increase o risk on the above it is not deemed significant enough to warrant a lower score under this scoring system.</td><td>3</td><td>3</td></tr>
<tr><td>4: L + R (d) & (e)</td><td>Generic for all variants</td><td>- Pipeline connections, pump stations, storage facility at risk from seismic. Events can be designed for, some remaining risk.
- Pipeline route at risk of land movement and erosion. Route design will assist in minimising risk but cannot be removed
- Scour risk at waterbody crossings
- Potential earthquake damage to storage facility and/or distribution infrastructure (land scheme). This option has only a small storage facility (comparatively). Events can be designed for, some remaining risk.
- Scouring & realignment of river may affect outlet
- Risk of lateral spreading with seismic activity</td><td></td><td>- Limited effects from high intensity rainfall peaks
- Prolonged wet weather will reduce the efficiency of the system and may cause increased leaching into groundwater. Prolonged wet weather may increase the risk of overflows from the storage lagoon, risk is managed with RI/contingency discharge.
- Prolonged dry periods are likely to improve the efficiency of land application
- Climate change physical effects on Manawatū River flow, resulting in longer low River flows, higher peaks, can be designed for</td><td></td><td></td></tr>
</table>

Option	Variant	Natural Hazards	Natural Hazards Score	Climate Change & Adaptation	Climate Change Score	Draft Resilience MCA Score
		- Potential disease risk to crops. This could have both financial (reduced return), and environmental (reduced nutrient uptake / increased leaching) impacts.				
	55 % applied to an inland land application site and a river discharge for the remainder of the time (d)	- Decreased risk from (L+R a) scores due to the smaller land application area	4	- Similar resilience to (L+R a) above	3	3.5
	45 % applied to an inland land application site and a river discharge for the remainder of the time (d)	- Decreased risk from (L+R a) scores due to the smaller land application area	4	- Similar resilience to (L+R a) above	3	3.5
	55 % applied to a coastal land application site and a river discharge for the remainder of the time (e)	- Increased risk from (L+R b) scores due to the larger land application area (lower level of treatment, larger land)	2	- Similar resilience to (L+R b) above	3	2.5
	45 % applied to a coastal land application site and a river discharge for the remainder of the time (e)	- Increased risk from (L+R b) scores due to the larger land application area (lower level of treatment, larger land)	2	- Similar resilience to (L+R b) above	3	2.5
6: Ocean	Generic for both variants	- Pipeline connections, pump stations, storage facility at risk from seismic. Events can be designed for, some remaining risk. - Pipeline route at risk of land movement and erosion. Route design will assist in minimising risk but cannot be removed - Scour risk at waterbody crossings - Potential earthquake damage to storage facility and/or distribution infrastructure (land scheme). This option has only a small storage facility (comparatively). Events can be designed for, some remaining risk. - Scouring & realignment of river may affect outlet - Risk of lateral spreading with seismic activity		- Limited effects from high intensity rainfall peaks, wastewater will go to ocean - Effects of prolonged dry periods on Manawatu River are largely not applicable as not direct discharge to river - Due to coastal location, some sea-level rise related risks, which effectively present as exacerbations of; storm-surge and/or flooding damage risk, erosion risk		
	Ocean discharge, with a small % to land	- Similar risk from (L+R b) score due to the smaller land application area, but includes ocean outfall	3	- Prolonged wet weather will reduce the efficiency of the system and may cause increased leaching into groundwater. Could be managed by going to ocean and irrigating over the other period of the year to retain 6-month average	3	3

Option	Variant	Natural Hazards	Natural Hazards Score	Climate Change & Adaptation	Climate Change Score	Draft Resilience MCA Score
				- Due to coastal location, some sea-level rise related risks, which effectively present as exacerbations of; storm-surge and/or flooding damage risk, erosion risk, groundwater table rise risks (potentially limiting useable area for forestry + reducing infiltration capacity of RI facility). - Long term increase in forest fire risk possible (if climate tends drier/hotter) - Sea level rise is expected to have only a limited effect (over 35-year time period) - Similar risk from (L+R b) score due to the smaller land application area, but includes ocean outfall		
	Ocean discharge	- Less risk than Ocean with land as no land element, but majority of risk from natural hazards in pipeline and outfall	3	- Less risk than Ocean with land as no land element	4	3.5

Note: Option 5, which involved a mix of groundwater discharge and land application, was removed from the short list during the short list development phase of the project.

1.7 Assessment Summary

Option	Variant	Draft score
1: R2(b)	River discharge with enhanced treatment	4
	River discharge with enhanced treatment, and a small % to land	3
2: Dual R + L	Two river discharge points and a small % to land	3.5
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	3
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	3
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	3.5
	55 % applied to an inland land application site and a river discharge for the remainder of the time	3.5
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	2.5
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	2.5
6: Ocean	Ocean discharge, with a small % to land	3
	Ocean discharge	3.5

1 Social Comparative Assessment of Short-listed options

1.1 Introduction

This is the social comparative assessment of the short-listed options for the Palmerston North Wastewater BPO project ("Nature Calls"). The assessment does not include an assessment of the social effects of increased rates.

This template has been provided by Stantec for use in the scoring. It is recommended a full social impact assessment be undertaken for the preferred option once confirmed.

This assessment has been undertaken by:

- Rachel Maas – author. 20+ years experience conducting SIAs in New Zealand and Australia. Bachelor of Science, Post Graduate Diploma (Social Impact Assessment), Masters of Evaluation, Certified Environmental Practitioner, Impact Assessment Specialist (CEnvp IA), member of Environment Institute of Australia and New Zealand (EIANZ) and International Association for Impact Assessment (IAIA).
- Julie Boucher – QA review. Post Graduate Diploma, Resources and Environmental Planning, Masters of Social Science (Geography), PMP, MNZPI, Licensed IAP2 Australasia Trainer, IAP2 Certificate of Public Participation.

1.2 Criterion and scoring approach

The social criterion description has changed since the Traffic Light Assessment. The previous description was the *potential adverse effects on social and community values relating to amenity, recreation and food gathering*. This description is dependent on the option and associated geographical locations for infrastructure and application (if required) being known. At this point of the Nature Calls project, we do not have this information so a different description was developed. The description takes into account the information that is known and described in the:

- Wastewater BPO Shortlist Options (as presented by Richard Peterson on Monday 21 September 2020) and
- Work Package 15.6/7 Shortlisted Options Summary Report, September 2020.

Criterion	Description	1	2	3	4	5
Social	Significance of potential social effects based on the gravity, distributive equity, the need for land acquisition and degree of permanence of land use change, and public support for the option	Severe	Major	Moderate	Minor	Insignificant

1.3 Approach to the assessment

The significance of potential social effects is based on a peer reviewed and published significance rating methodology developed by Esteves et al 2017[1]. The rating methodology has been adapted to the BPO project. The methodology is based on identifying significance from the perspective of the people likely to experience social effects.

Each option has been assessed against the following sub-criteria:

Social Criterion	Description	Level
Gravity	Option will cause death or adverse health effects that could lead to significant reduction in quality of life and/or longevity and/or continued exposure is generally likely to lead to long term limiting illness or disease	G1
	Infringement in access to: • Basic life necessities (including education, livelihood etc) and/or • Cultural, economic, natural or social infrastructure/assets that have been identified as highly valued by identified groups or subject matter experts • Ecosystem services identified as priority to livelihoods[2], health, safety or culture by identified groups or subject matter experts	G2
	All other impacts	G3
Distributive equity	Waste water treated in PNCC and part of the water discharged into the river and/or part of the water conveyed out of PNCC area so treated water can be applied to land outside the PNCC area	E1
	Waste water treated in PNCC area and all discharge into the river within PNCC or piped to the ocean for discharge	E2

[1] Esteves, AM., Factor, G., Vanclay, F., Götzmann, N., Moreira, S. (2017) Adapting social impact assessment to address a project's human rights impacts and risks *Environmental Impact Assessment Review* 67 73 - 87

[2] Livelihoods refers to the way of life a person or household and how they make a living, in particular, how they secure the basic necessities of life, e.g. their food, their water, shelter and clothing and live in the community (IAIA SIA Guidance 2015:87)

Social Criterion	Description	Level
	Waste water treated in PNCC area and treated water applied to land wholly within PNCC area	E3
Need for land acquisition and degree of permanence of land use change	Yes with permanent land/water use changes	PC1
	Yes with temporary land/water use changes (able to be reversed) or no need for acquisition	PC2
Public support for the option[3]	Little or no support based on feedback from the public (<25% of feedback identified as most preferred)	S1
	Feedback doesn't provide a clear indication of support (25 – 50% feedback identified as most preferred)	S2
	High level of support based on feedback from the public (>50% of feedback identified as most preferred)	S3

The significance of potential social effects is then calculated using the following table

Specification of conditions for assigning significance	Rating	Score
G1 (regardless of any other criteria), or G2 and PC1 and S1/S2 (regardless of distributive equity)	Severe	1
G2 and PC1 and S3 (regardless of distributive equity), or G2 and PC2 and E1/E2 and S1/S2	Major	2
G2 and PC2 and E3 (regardless of support), G3 and PC1 (regardless of extent and support) or G3 and E1/E2 and R1/R2 (regardless of support)	Moderate	3
G3 and E1/E2 and PC2 and S3	Minor	4
G3 and E3 and PC2 and S3	Insignificant	5

1.4 Assumptions applied in the assessment

- There has been no decision as the location of the land application options or ocean option.
- Land (inland or coastal) options are:

[3] Based on PNCC calculation of most preferred option. Public ranked option preference on PNCC submission forms during the consultation period from 3 June – 10 July 2020.

    - currently used to generate economic livelihoods (e.g. farming or tourism) and
    - have people living on the land who actively participate in their communities:
        - informal social networks (friends and family) and
        - formal networks e.g. resident and rate payers associations, schools, churches, environmental groups
- Conveyance of wastewater outside PNCC is a buried pipeline within existing road corridor with temporary land use changes only. Pump stations assumed to have minimal social effects due to an assumed small footprint.

Comparison of PNCC Consultation options and MCA options:

Option for public consultation	MCA Option
Option 1 – All treated wastewater is discharged to the Manawatū River, with improved removal of phosphorus and nitrogen	1 R2(b)
Option 2 – Treated wastewater discharged to Manawatū River at Tōtara Road, below Opiki Bridge, with some land application	2: Dual R + L
Option 3 – Treated wastewater applied to land, with discharge to the Manawatū River in exceptional circumstances	3 L + R (a) & (b)
Option 4 – Treated wastewater applied to land, with some discharge to the Manawatū River	4: L + R (d) & (e)
Option 5 – Discharge to groundwater via infiltration, with land application in the drier months of the year	Not included in MCA
Option 6 – Most of the treated wastewater discharged to the ocean with some applied to land	6:O + L

1.5 Assessment table

The following table sets out the preliminary assessment of the options by the authors. This will be used as a starting point for discussion at the MCA workshop. The final MCA assessment and score may therefore differ from what is set out below.

Reports relied upon

- Wastewater BPO Shortlist Options (as presented by Richard Peterson on Monday 21 September 2020)
- Traffic Light Workshop Briefing Report, 24 April 2019, Appendix 5 (Social and Community Comparative Assessment)
- Work Package 15.6/7 Shortlisted Options Summary Report, September 2020
- Stage 1 Engagement Summary, 17 December 2018
- Report on Shortlist Consultation V2
- Option descriptions on the PNCC website, https://www.pncc.govt.nz/participate-palmy/have-your-say/nature-calls/

<table>
<tr><th rowspan="2">Option</th><th rowspan="2">Variant</th><th colspan="6">Assessment</th></tr>
<tr><th>Gravity</th><th>Distributive equity</th><th>Land/water change/ acquisition</th><th>Public support</th><th>Rating</th><th>Draft score</th></tr>
<tr><td rowspan="4">1: R2(b)</td><td rowspan="2">River discharge with enhanced treatment</td><td>G2</td><td>E2</td><td>PC1</td><td>S2</td><td rowspan="2">Major</td><td rowspan="2">2</td></tr>
<tr><td>Significance of the Manawatū River (social/ recreation), and livelihood connection)</td><td>Waste water treated in PNCC and discharged into the river via wetland and land passages</td><td>Yes with permanent land use changes</td><td>27% of the public nominated Option 1 as “most preferred”</td></tr>
<tr><td rowspan="2">River discharge with enhanced treatment, and a small % to land</td><td>G2</td><td>E1</td><td>PC1</td><td>S2</td><td rowspan="2">Severe</td><td rowspan="2">1</td></tr>
<tr><td>Significance of the Manawatū River (livelihoods and recreation) and impacts on land that is currently supporting livelihoods</td><td>Waste water treated in PNCC and part of the water discharged into the river and/or part of the water conveyed out of PNCC so treated water can be ‘applied’ outside the PNCC area</td><td>Yes with permanent land use changes</td><td>27.23% of the public nominated Option 1 as “most preferred”</td></tr>
<tr><td colspan="2">2: Dual R + L</td><td>G2</td><td>E1</td><td>PC1</td><td>S1</td><td>Severe</td><td>1</td></tr>
</table>

Option	Variant	Assessment				Rating	Draft score
		Gravity	Distributive equity	Land/water change/ acquisition	Public support		
	Two river discharge points and a small % to land	Significance of the Manawatū River (livelihoods and recreation) and impacts on land that is currently supporting livelihoods	Waste water treated in PNCC and part of the water discharged into the river (Opiki River discharge located outside PNCC) and/or part of the water conveyed out of PNCC so treated water can be 'applied' outside the PNCC area	Yes with permanent land use changes	16.95% of the public nominated Option 2 as "most preferred"		
3: L+R (a) & (b)	97 % applied to an inland land application site and a discharge to river in exceptional circumstances	G2	E1	PC1	S2	Severe	1
		Impacts on land that is currently supports livelihoods	Waste water treated in PNCC and part of the water discharged into the river and part of the water conveyed out of PNCC so treated water can be	Yes with permanent land use changes	27.41% of the public nominated Option 3 as "most preferred"		

Option	Variant	Assessment					Draft score
		Gravity	Distributive equity	Land/water change/ acquisition	Public support	Rating	
			‘applied’ outside the PNCC area				
	97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	G2	E1	PC1	S2	Severe	1
		Impacts on land that is currently supports livelihoods	Waste water treated in PNCC and part of the water discharged into the river and part of the water conveyed out of PNCC so treated water can be ‘applied’ outside the PNCC area	Yes with permanent land use changes	27.41% of the public nominated Option 3 as “most preferred”		
4: L + R (d) & (e)	45 % applied to an inland land application site and a river discharge for the remainder of the time	G2	E1	PC1	S3	Severe	1
		Significance of the Manawatū River (livelihoods and recreation) and impacts on land that is currently supporting livelihoods	Waste water treated in PNCC and part of the water discharged into the river and part of the water conveyed out of PNCC so treated water can be	Yes with permanent land use changes	8.30% of the public nominated Option 4 as “most preferred”		

Option	Variant	Assessment: Gravity	Assessment: Distributive equity	Assessment: Land/water change/ acquisition	Assessment: Public support	Rating	Draft score
			'applied' outside the PNCC area				
	55 % applied to an inland land application site and a river discharge for the remainder of the time	G2 Significance of the Manawatū River (livelihoods and recreation) and impacts on land that is currently supporting livelihoods	E1 Waste water treated in PNCC and part of the water discharged into the river and part of the water conveyed out of PNCC so treated water can be 'applied' outside the PNCC area	PC1 Yes with permanent land use changes	S3 8.30% of the public nominated Option 4 as "most preferred"	Severe	1
	45 % applied to a coastal land application site and a river discharge for the remainder of the time	G2 Significance of the Manawatū River (livelihoods and recreation) and impacts on land that is currently supporting livelihoods	E1 Waste water treated in PNCC and part of the water discharged into the river and part of the water conveyed out of PNCC so treated water can be	PC1 Yes with permanent land use changes	S3 8.30% of the public nominated Option 4 as "most preferred"	Severe	1

Option	Variant	Assessment: Gravity	Distributive equity	Land/water change/ acquisition	Public support	Rating	Draft score
			'applied' outside the PNCC area				
	55 % applied to a coastal land application site and a river discharge for the remainder of the time	G2	E1	PC1	S3	Severe	1
		Significance of the Manawatū River (livelihoods and recreation) and impacts on land that is currently supporting livelihoods	Waste water treated in PNCC and part of the water discharged into the river and part of the water conveyed out of PNCC so treated water can be 'applied' outside the PNCC area	Yes with permanent land use changes	8.30% of the public nominated Option 4 as "most preferred"		
6: Ocean	Ocean discharge, with a small % to land	G2	E1	PC1	S3	Severe	1
		Significance of ocean (recreation and livelihoods) and impacts on land currently supporting livelihoods	Waste water treated in PNCC and part of the water discharged into the river and part of the water conveyed out of PNCC so treated water can be	Yes with permanent land use changes	6.76% of the public nominated Option 6 as "most preferred"		

Option	Variant	Assessment					
		Gravity	Distributive equity	Land/water change/ acquisition	Public support	Rating	Draft score
			'applied' outside the PNCC area				
	Ocean discharge	G2	E2	PC2	S1	Major	2
		Significance of ocean (recreation and livelihoods) and impacts on land currently supporting livelihoods	Waste water treated in PNCC and conveyed to the ocean for discharge	No need for land acquisition	6.76% of the public nominated Option 4 as "most preferred"		

<u>Note:</u> Option 5, which involved a mix of groundwater discharge and land application, was removed from the short list during the short list development phase of the project.

Appendix 3: MCA Workshop Material & Notes

PALMERSTON NORTH

NATURE CALLS

Wastewater BPO
Day 1

Collaborative MCA

9th & 10th November

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Karakia

PALMERSTON NORTH NATURE CALLS

Welcome from the Mayor

5 mins

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

MCA – Workshop Agenda

Sara Dennis - Just Add Lime

5 mins

Agenda for Day 1- Gain Insight & shared understanding

Technical specialist

- How they went about scoring specific criteria & why

Understanding the Options

- Consolidated scores from specialist's
- Discuss to collectively understand/further group input
- Build up an integrated story about each option - integrated specialist view

Overall option score variation

- scoring high/low

Collectively agree weighting (if any, will apply overnight)

Refresh MCA scores based on collective inputs/enhanced understanding (if any, will apply overnight)

Breaks

Morning Tea	10.30 – 10.45
Lunch	12.30 – 1.15
Afternoon Tea	3.15 – 3.30

Agenda for Day 2 – Trade off between the options

Weighting Sensitivity Testing

- Weighted option scoring results
- Lock in the weighting(if any)

Preferred Option(s)

- Can we shortlist a preferred option(s)?

Summary wrap up

- Option story

Next steps

- What further information do we need going forward

PALMERSTON NORTH
NATURE CALLS

Introduction

Robert Van Bentum – Transport & Infrastructure Manager

Melaina Voss – BPO Project Manager

10 mins

Wastewater Project Charter Tu-Tohinga

PALMERSTON NORTH
NATURE CALLS

VISION PAE TAWHITI

Management of the City's wastewater which enables growth, protects and enhances the environment and contributes to improving the health and mauri of the Manawatū River.

Ko te whakahaere I te parawai o Papioea, e pai ait e tipu o te taonga, e rauhītia ai te taiao, e piki anō ai te ora me te mauri o Te Awa o Manawatū.

TREATY COMMITMENT TE MANAWA TITIKAHA KI TE TIRITI O WAITANGI

As per National Policy Statement on freshwater, provide for the involvement of iwi and hapū, and to ensure that tāngata whenua values and interests are identif ed and ref ected in the management of fresh water including associated ecosystems, and decision-making regarding freshwater planning;

PROJECT OBJECTIVES PAE TATA

A best practicable option wastewater management solution that is developed in partnership with Rangitāne o Manawatū which:

1. Protects public health and minimises public health risks.
2. Minimises adverse environmental ef ects on air, land and water;
3. Is sustainable, enduring, and resilient;
4. Contributes to improving the health and mauri of the Manawatū River;
5. Takes an integrated approach to the management of the Manawatū River Catchment including understanding cumulative ef ects;
6. Enhances peoples use and enjoyment of the Manawatū River
7. Is af ordable and cost ef ective;
8. Minimises whole of life carbon emissions and optimises resource recovery;
9. Is innovative while being evidence based;
10. Facilitates long term growth and economic development
11. Is developed with the active engagement of the community and key stakeholders

VALUES UARA

Decision making processes followed during the project shall be:

a. Evidence based;
b. Ef cient and timely;
c. Undertaken to meet the requirements of the current resource consent (in terms of the scope of the BPO review); and
d. Consistent with the National Policy Statement for Freshwater Management, the National Policy Statement on Urban Development Capacity and the One Plan.
e. PNCC and Horizons work collaboratively in developing the best practicable option for the management of the City's wastewater.

PROJECT STRUCTURE TE HANGA O TE KAUPAPA

The current roles and responsibilities of the groups associated with the project are summarised in the infographic to the right –

PALMERSTON NORTH CITY COUNCIL
(decision making and funding body)

Project Steering Group *(provides governance, oversight and direction to the BPO Review Project)*
Membership Elected Members | Rangitane Reps | Council Of cers
Advisors BPO PM | Professional Advisors | Council Staf

⟷

ENGAGEMENT AND COMMUNICATION

Public and Community
Technical Advisory Group
Special Interest Groups – Iwi

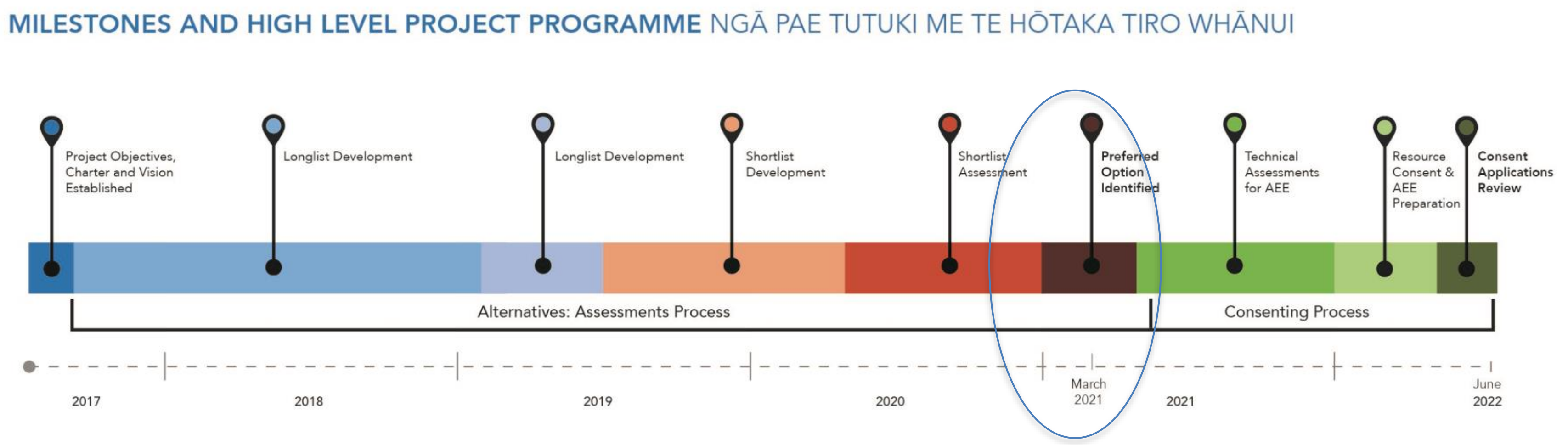
STAKEHOLDER ENGAGEMENT TE WHAI WĀHITANGA MAI O TE HUNGA WHAIPĀNGA

This section will outline the focus and broad approach to community and stakeholder engagement. A draft Communication and Engagement Plan is being prepared.

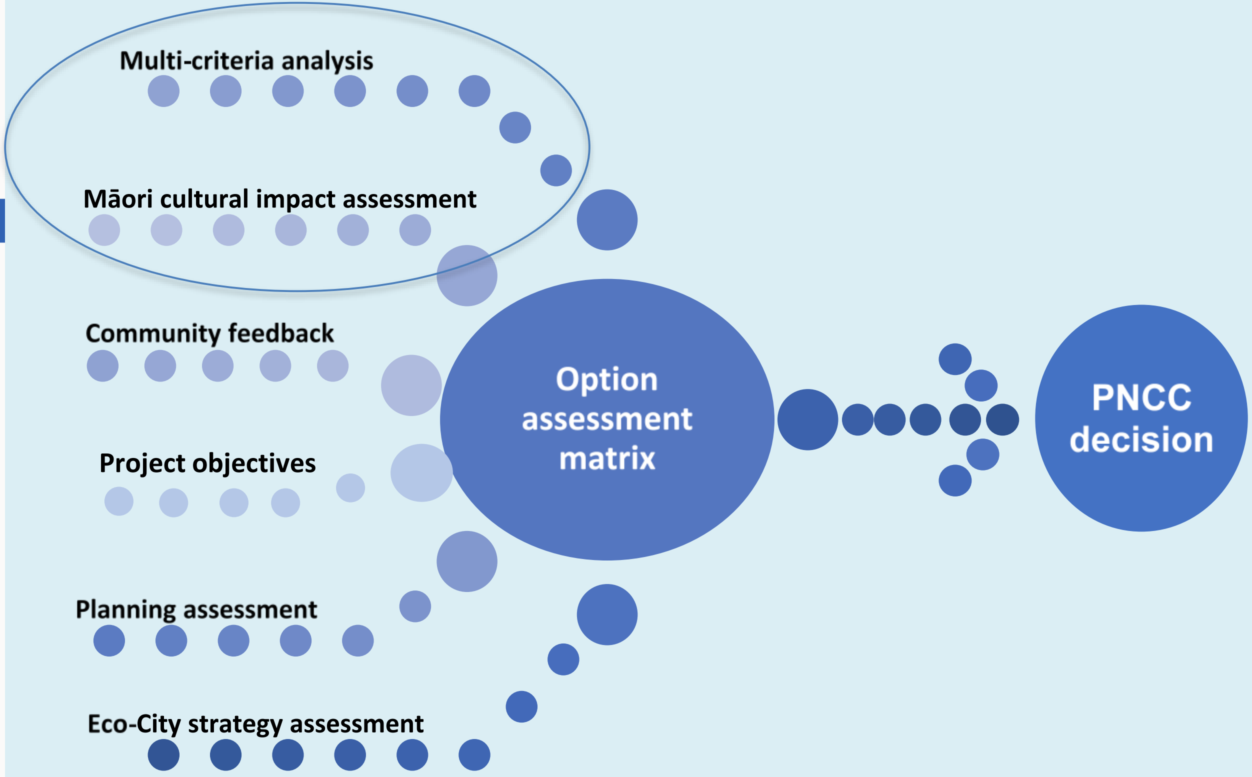
What we have achieved so far

- Contextual review and understanding of our future growth and infrastructure needs
- Development of longlist options, evaluation and refinement to a shortlist
- Investigation into potential receiving environments and the environmental and environmental legislation constraints
- Closely working with Horizons Regional Council
- Community and stakeholder engagement
- Closely working with Rangitane o Manawatu along the way. Now working with neighbouring Iwi.

Where we are in our decision-making process

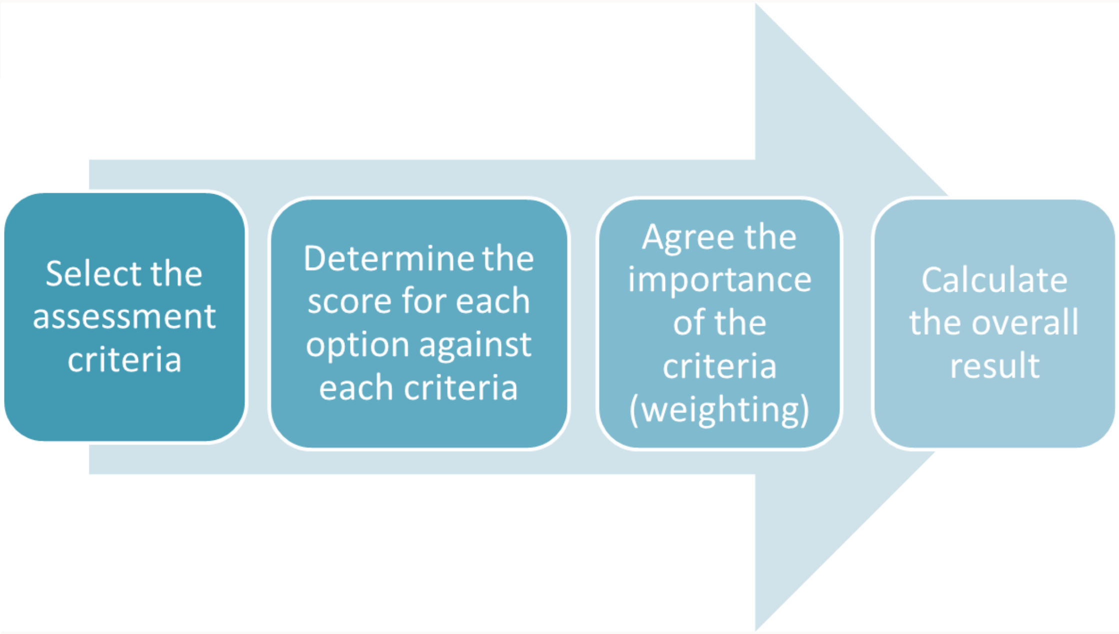


Overall Approach



Multi-Criteria Analysis (MCA)

- Systematic way of comparing options using a range of criteria
- For complex problems it provides a **relatively** simple way of comparing their merits
- MCA does have limitations that need to be kept in mind - inherent ‘subjectivity’ and unconscious bias of the participants – sensitivity testing
- Use a collaborative workshop process, involving partners and stakeholders



Specialist Assessment

Sara Dennis – 2 hours with

8 Specialists 15 mins each

Cultural Context

Assessment Criteria

Public Health

Degree of public exposure to health risks in treated wastewater (including through land application or re-use options)

Māori Cultural Values

Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Māori, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga

Financial Implications

Comparative capital, operational, whole of life costs of the option. Where relevant to the option, assessment of this criterion includes consideration of land acquisition costs, capital gains and product net revenue.

Natural Environment

Potential adverse environmental effects on the receiving environment (including the Manawatū River), particularly in relation to water quality (including the matters listed in s107 (1) (c) to (g)), soils, aquatic ecology and terrestrial ecology

Resilience

Degree to which the option is resilient to natural hazards and climate change and offers operational resilience.

Growth & Economic Development

Will the option support the population and economic growth anticipated for the City by Council?

Social & Community Considerations

Significance of potential social effects based on the gravity, distributive equity, the need for land acquisition and degree of permanence of land use change, and public support for the option

Technology & Infrastructure

Degree to which the option:

- Uses reliable & proven technology
- Can be staged
- Able to be constructed
- Constructed within app timeframe
- Allows resource recovery/beneficial re-use

PALMERSTON NORTH

NATURE CALLS

Jim Bradley – Stantec
Brett Munro – MidCentral DHB
Stephen Palmer – Regional Public Health

Public Health

Degree of public exposure to health risks in treated wastewater (including through land application or re-use options)

Public Health

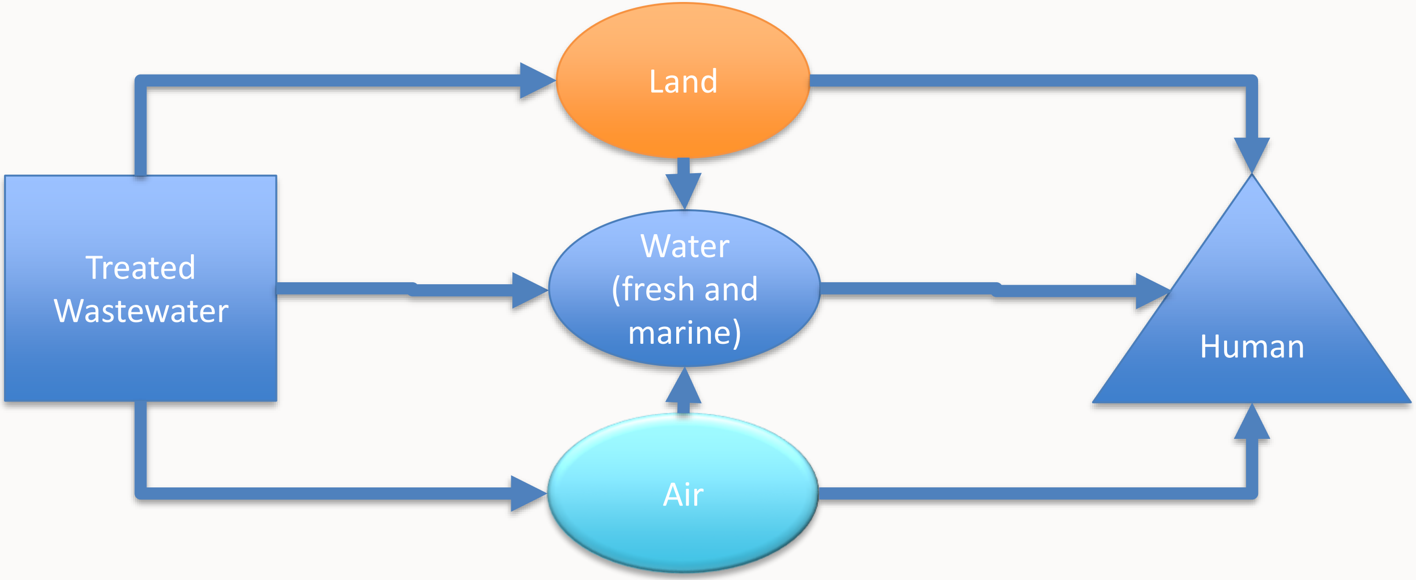
Methodology is based on the potential for Public Health Risk from human contact with the treated wastewater

Uses a conceptual exposure pathway methodology

Recommended criteria based on number of identified critical exposure pathways:

- **differentiates between options**
- **focuses on critical pathways**
- **reflects the potential difficulty in managing the risk to public health resulting from the treated wastewater**

Public Health – Conceptual Exposure Pathways



Public Health

Criteria Selection

1 Low	2 Low - medium	3 medium	4 Medium - high	5 High
Catastrophic: health effects affect a larger group of people across a wider area, which requires a larger scale of public health response with contact tracing. All persons affected only experience a major illness, which is likely to be dangerous to sensitive members of the community	Major: health effects affect a larger group of people across a wider area, which requires a larger scale of public health response with contact tracing. All persons affected only experience a moderate illness, which may be dangerous to sensitive members of the community	Moderate: health effects affect a larger group of people across a wider area, which requires a larger scale of public health response with contact tracing. All persons affected only experience a minor illness	Minor: health effects are limited to a single person, single household or single group of people who can be readily identified and contacted by the public health authorities and the consent holder for appropriate advice who experience a minor illness	Insignificant: illness resulting from the treated wastewater discharge is indiscernible above the normal background level of illness in the community.

PALMERSTON NORTH

NATURE CALLS

Keith Hamill – River Lake
Olivier Ausseil – Aquanet
Aslan Perwick – PDP

Natural Environment

Potential adverse environmental effects on the receiving environment (including the Manawatū River), particularly in relation to water quality (including the matters listed in s107 (1)(c) to (g)), soils, aquatic ecology and terrestrial ecology

Natural Environment: Key considerations

Rivers and Lakes

- Nutrients to Manawatū causing periphyton growth and exceeding OP targets (used PointSim Model)
- Effects on river less at high flows and downstream of Opiki.
- Risk from land treatment to small streams / lakes (considered N leaching rate cf. current landuse, irrigation area/location)

Coastal

- Near shore zone and benthic habitats near the outfall.

Groundwater & Soils

- N leaching rate, seasonal application, ability to avoid sensitive areas and apply buffer zones.

Natural Environment Scoring Criteria

Score	Adverse Effect	Description	Example
1	Very High	Major loss or change in baseline conditions.	One Plan (OP) targets regularly exceeded. Risk of chronic toxicity.
2	High	Major change in baseline conditions.	
3	Moderate	Moderate change in baseline but generally acceptable.	OP targets generally met but risk of occasional exceedance. Minor effects on soils.
4	Low	Small shift from baseline.	
5	Very Low	Very slight change from baseline.	Negligible ecological effects. Risk to exceeding OP targets is very low. Negligible to positive effect on GW. Benefits to soils.

PALMERSTON NORTH
NATURE CALLS

Jonathan Proctor – Rangitane
Danielle Harris - Rangitane

Māori Cultural Values

Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Māori, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga

Māori Cultural Values

Context

- The assessment was undertaken by the Rangitāne o Manawatū representatives and Te Ao Turoa staff. Key concepts focused on;
  - Cultural Values
  - Cultural Landscapes
  - Atua
  - Potential Acceptance to our people

- Options discussed in 3-4 half day hui. Values and assessments undertaken in 2 wananga

- Rangitāne o Manawatū also invited neighbouring Iwi Ngati Apa, Muaupoko and Ngati Kauwhata.

<u>Fundamentals</u>

Protection of Rangitāne o Manawatū, Protection of the River, Enhancement for the people and future

Māori Cultural Values

Criteria Selection

Criterion	Description	1	2	3	4	5
Rangitāne Cultural Values	Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Rangitāne o Manawatū, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga	Destruction of Rangitāne culture, connections and kaitiakitanga. Critical effect on Rangitāne o Manawatū	Significant effect or impact on all aspects of Rangitāne Mana, Toanga, Atua and natural resources	Major impact on all aspects of Rangitāne significant sites and natural resources	Minimal impact on Rangitāne significant sites and natural resources	Minimal to no effect on Rangitāne o Manawatū

Māori Cultural Values

Significance

- The Mana of Rangitāne o Manawatū would be recognised through having the activities contined within in the Manawatū / Rangitāne o Manawatū Rohe
- The Manawatū River is not to be further impacted
- The Coast and its resources are not to be impacted or threatened
- Must be future focused, plan for growth, three waters development – more important than short time cost
- Rangitāne o Manawatū believe the is an error not to make continued improvements in treatment before discharge– strong desire to work towards treating to "drinking water standards"
- Neighbouring Iwi maintain the ability to make their own decisions and contribution.

Julie Boucher – Just Add Lime

Social & Community Considerations

Significance of potential social effects based on the gravity, distributive equity, the need for land acquisition and degree of permanence of land use change, and public support for the option

Social & Community Considerations

Context

- Based on engagement to date
- Not dependent on specific location
- Consideration of distributional impacts
- Accepted methodology

Social & Community Considerations

Criteria Selection

Criteria	Description	Level
Gravity	Option will cause death or adverse health effects that could lead to significant reduction in quality of life and/or longevity and/or continued exposure is generally likely to lead to long term limiting illness or disease	G1
	Infringement in access to: • Basic life necessities (including education, livelihood etc) and/or • Cultural, economic, natural or social infrastructure/assets that have been identified as highly valued by identified groups or subject matter experts • Ecosystem services identified as priority to livelihoods[1], health, safety or culture by identified groups or subject matter experts	G2
	All other impacts	G3
Distributive equity	Waste water treated in PNCC and part of the water discharged into the river and/or part of the water conveyed out of PNCC area so treated water can be applied to land outside the PNCC area	E1
	Waste water treated in PNCC area and all discharge into the river within PNCC or piped to the ocean for discharge	E2
	Waste water treated in PNCC area and treated water applied to land wholly within PNCC area	E3

Social & Community Considerations

Criteria Selection cont

Criteria	Description	Level
Need for land acquisition and degree of permanence of land use change	Yes with permanent land/water use changes	PC1
	Yes with temporary land/water use changes (able to be reversed) or no need for acquisition	PC2
Public support for the option[2]	Little or no support based on feedback from the public (<25% of feedback identified as most preferred)	S1
	Feedback doesn't provide a clear indication of support (25 – 50% feedback identified as most preferred)	S2
	High level of support based on feedback from the public (>50% of feedback identified as most preferred)	S3

Social & Community Considerations

Significance

The significance of potential social effects is then calculated using the following table

Specification of conditions for assigning significance	Rating	Score
G1 (regardless of any other criteria), or G2 and PC1 and S1/S2 (regardless of distributive equity)	Severe	1
G2 and PC1 and S3 (regardless of distributive equity), or G2 and PC2 and E1/E2 and S1/S2	Major	2
G2 and PC2 and E3 (regardless of support), G3 and PC1 (regardless of extent and support) or G3 and E1/E2 and R1/R2 (regardless of support)	Moderate	3
G3 and E1/E2 and PC2 and S3	Minor	4
G3 and E3 and PC2 and S3	Insignificant	5

Anna Bridgeman - Stantec

Resilience

Degree to which the option is resilient to natural hazards and climate change and offers operational resilience.

Resilience Categories

Natural Hazards

- Risks of earthquakes
- Land movement and erosion
- Flooding
- Storm surge/tsunami

Climate Change and Adaptation

- High intensity rainfall peaks
- Prolonged wet weather periods
- Prolonged dry periods
- Prolonged dry periods resulting in an increase of low flows in the Manawatū River flows,
    - increased levels of treatment (phosphorous and nitrogen removal for greater periods of time)
- Sea level rise

Resilience Criterion

Method of Assessment

- Degree to which option is resilient to natural hazards & climate change – from LOW to HIGH
- Comparative comparison between the options
- Overall score given based on the average of sub-category scores

Criterion	Description	1	2	3	4	5
Resilience	Degree to which the option is resilient to • natural hazards • climate change	Low degree of resilience	Low – Medium degree of resilience	Medium degree of resilience	Medium – High degree of resilience	High degree of resilience

PALMERSTON NORTH

NATURE CALLS

Melaina Voss – Stantec
Richard Peterson - Stantec

Growth & Economic Development

Will the option support the population and economic growth anticipated for the City by Council?

Growth & Economic Development

Context

- Based on growth projects for the next 35 years – 50 years
- No specific sites identified
- Considering Councils growth and economic development strategies as well as the regions plans (known)
- Consideration of capacity to provide a sub-regional scheme ie additional flows and loads as well as proximity to connect other wastewater systems

Growth & Economic Development

Criteria Selection

Criterion	Description	1	2	3	4	5
Growth and Economic Development	The degree to which the options will: • Support the population and economic growth anticipated for the City by Council? • Support / restrict further up-scaling to accommodate a sub-regional scheme?	Low degree	Low – Medium degree	Medium degree	Medium – High degree	High degree

Morning Tea

10.30 – 10.45am

Anna Bridgeman - Stantec

Technology & Infrastructure

Degree to which the option:

- Uses reliable & proven technology
- Can be staged
- Able to be constructed
- Constructed within app timeframe
- Allows resource recovery/beneficial re-use

Technology & Infrastructure Categories

- Can be Staged
- Is able to be constructed and operational within 5 years of the commencement of the consent
- Allows for resource recovery / beneficial re-use
- Infrastructure can be up-scaled, prior to and post initial construction, to accommodate a sub-regional scheme
- Involves Operational/Technical Complexity
- Involves Operational Risk

Criteria Selection

- Each of the six sub-criteria were scored with regards to how well the option aligned with that sub-criteria.
  - LOW to HIGH for alignment with the first four sub-criteria
  - HIGH to LOW for Operational Complexity & Risk
- The overall draft score is an average of these six scores, rounded to the nearest 0.5
- Each sub-criteria given equal weighting.
- Average has been used rather than the lowest score as it is not believed that any one of these sub-criteria is the governing factor in the selection of the BPO.

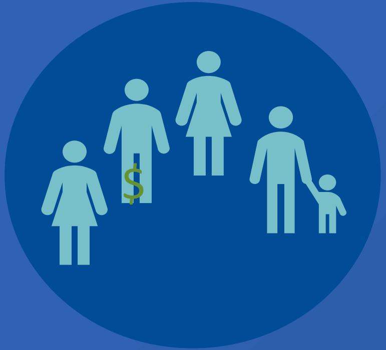
Criterion	Description	1	2	3	4	5
Technology and Infrastructure	Degree to which the option: • can be staged • is able to be constructed and operational within 5 years of the commencement of the consent • allows for resource recovery / beneficial re-use • infrastructure can be up-scaled, prior to and post initial construction, to accommodate a sub-regional scheme • involves Operational Complexity • involves Operational Risk	Low degree of alignment with sub-criteria and/or High Operational Complexity and Risk	Low – Medium degree of alignment with sub-criteria and/or Medium-High Operational Complexity and Risk	Medium degree of alignment with sub-criteria and/or Medium Operational Complexity and Risk	Medium – High degree of alignment with sub-criteria and/or Low-Medium Operational Complexity and Risk	High degree of alignment with sub-criteria and/or Low Operational Complexity and Risk

Technology & Infrastructure Criterion

Method of Assessment

- Each of the six sub-criteria were scored with regards to how well the option aligned with that sub-criteria.
    - LOW to HIGH for alignment with the first four sub-criteria
    - HIGH to LOW for Operational Complexity & Risk
- The overall draft score is an average of these six scores, rounded to the nearest 0.5
- Each sub-criteria given equal weighting.
- Average has been used rather than the lowest score as it is not believed that any one of these sub-criteria is the governing factor in the selection of the BPO.

Anna Bridgeman - Stantec



Financial Implications

Comparative capital, operational, whole of life costs of the option. Where relevant to the option, assessment of this criterion includes consideration of land acquisition costs, capital gains and product net revenue.

Financial Implications Comparative Assessment

Methodology

- **Step 1** – Development of capital cost and operational and maintenance cost for each component

- **Step 2** – NPV assessment using Capital Cost and OPEX estimates
  - 35 year NPV from 2025
  - 6% discount rate
- **Step 3** – Sub-criteria of Capital, O&M and NPV given a weighting
- **Step 4** – Sub-criteria score for Option X = ((1 – (cost of option X / highest cost)) x 4) +1
- **Step 5** – Overall score = Combination of Sub-criteria scores x weighting

Financial Implications Comparative Assessment

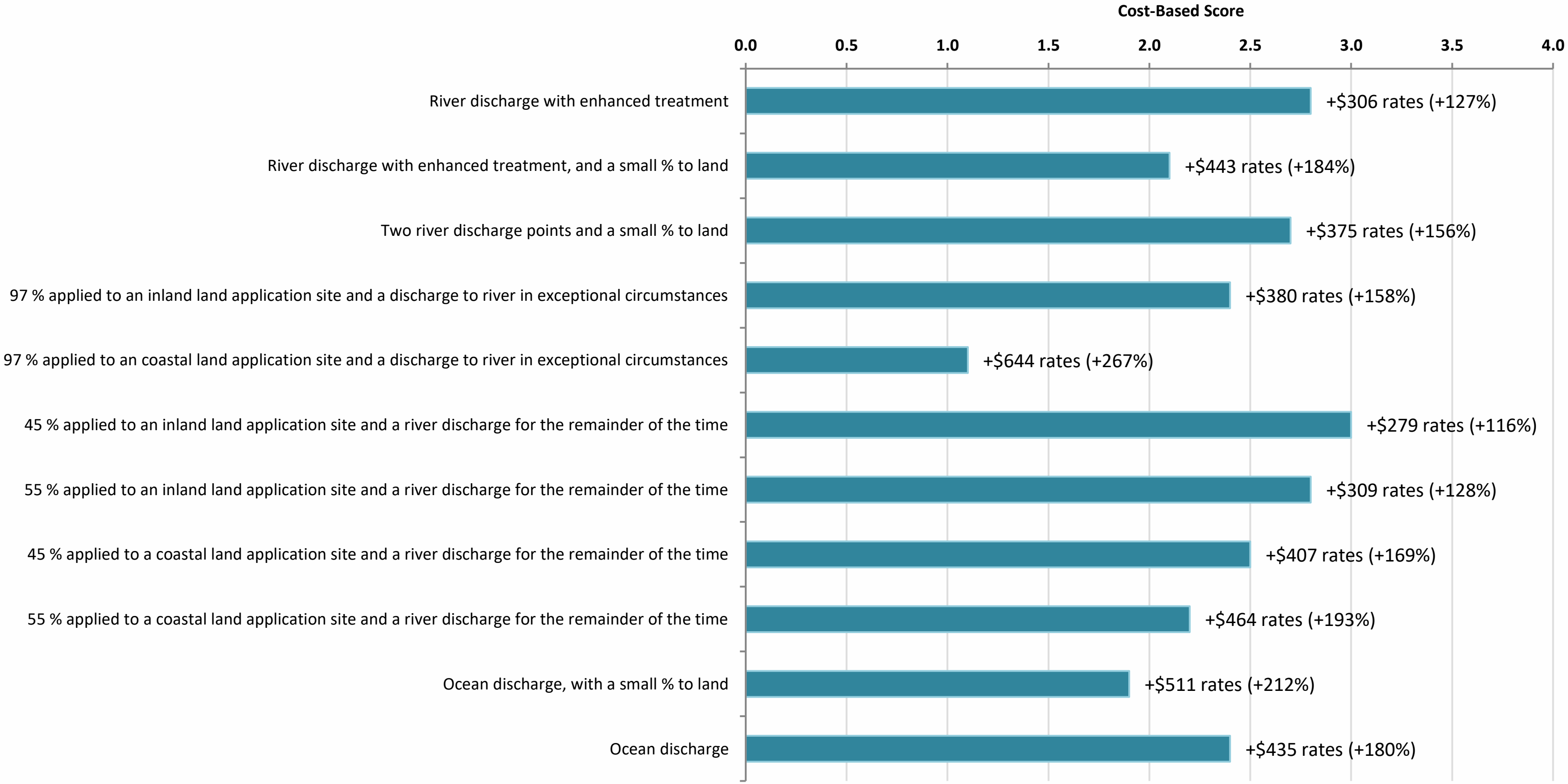
Sensitivity

- **Discount Rate**
  - 6% discount rate has been used through for the option development in the longlist and shortlist phases.
  - Treasury now recommends a 5% discount rate for infrastructure projects
  - Changing the discount rate to 4% and 8% increased or decreased the NPV between 3 - 10% higher and 2 - 7% lower respectively for the options,
    - greatest change 'River with enhanced treatment options'.
    - The level of change dependent on operational and maintenance costs and the return received from crops/forestry for the option.

- **Sub-Criteria Weighting**
  - Initial weighting of 37%, 30% and 33% for cost, O&M and NPV respectively
  - Changing this weighting did not change the top four – some movement between them, but no change overall

PALMERSTON NORTH NATURE CALLS

A FRESH LOOK AT HOW WE MANAGE WASTEWATER



PALMERSTON NORTH

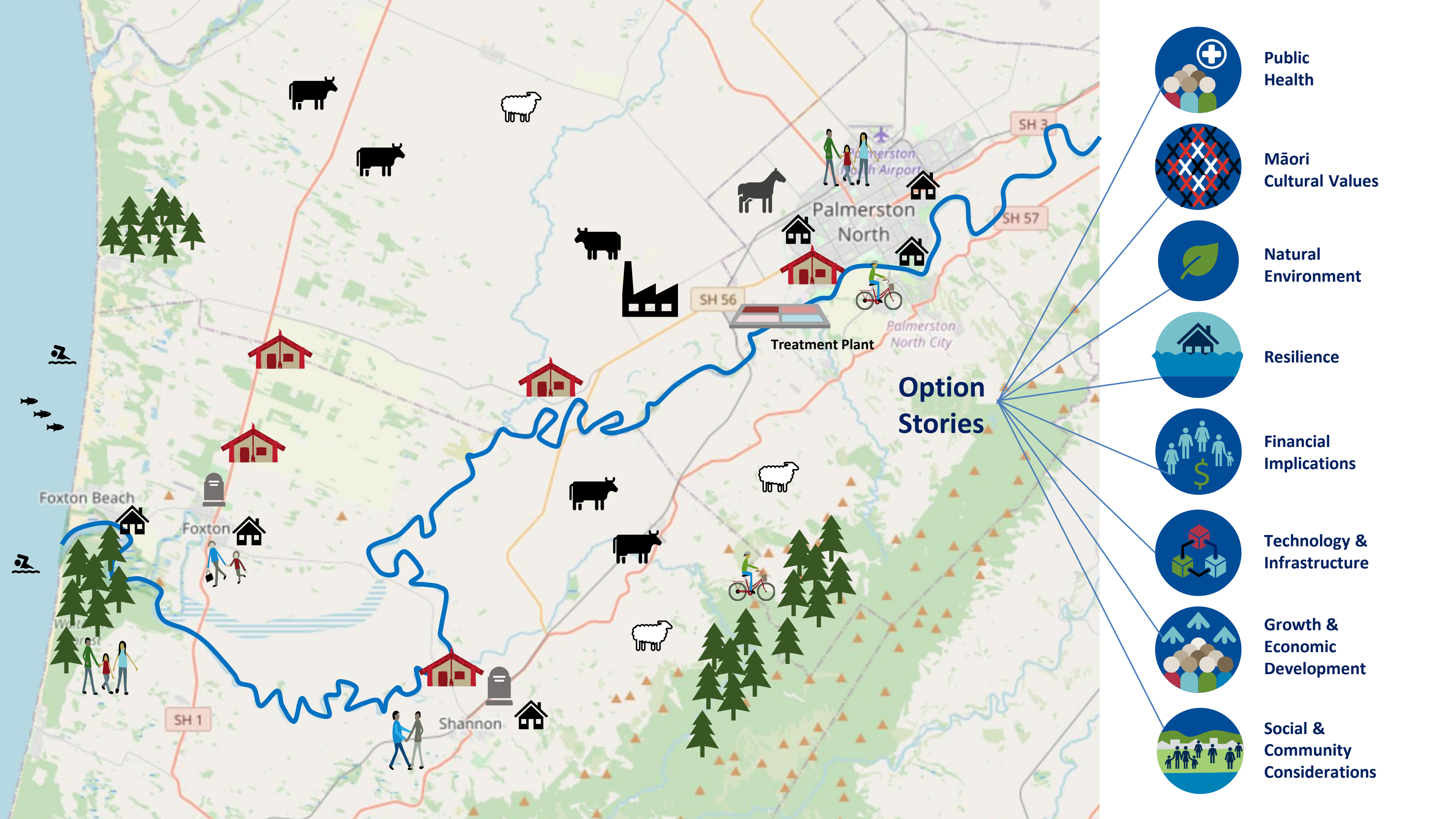
NATURE CALLS

Understanding the options

Robert Van Bentum – Transport & Infrastructure Manager

Melaina Voss – BPO Project Manager

2 ½ hours



SH 3
Palmerston North
SH 57
SH 56
Treatment Plant
Palmerston North City
Foxton Beach
Foxton
Shannon
SH 1
Option Stories
Public Health
Māori Cultural Values
Natural Environment
Resilience
Financial Implications
Technology & Infrastructure
Growth & Economic Development
Social & Community Considerations

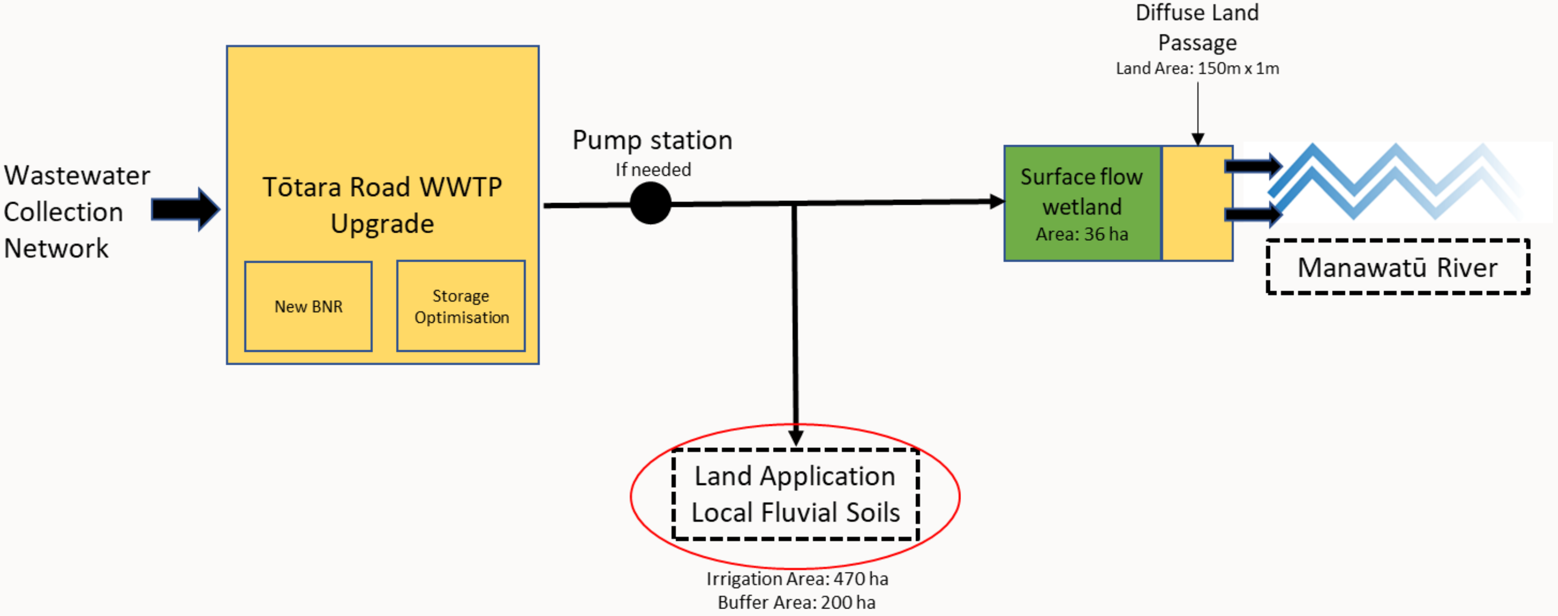
PALMERSTON NORTH NATURE CALLS

Option 1 - River discharge with enhanced treatment

30 mins

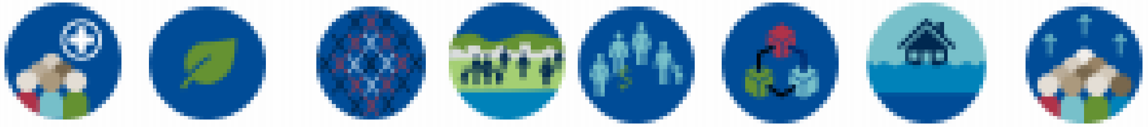
HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Option 1 – Schematic & Description



Option 1 - Scoring

SPECIALIST SCORING



OPTION VARIANTS	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
River discharge with enhanced treatment	4	3	1	2	2.8	4	4	2	22.8
River discharge with enhanced treatment, and a small % to land	2.5	3.5	1	1	2.1	4	3	2.5	19.6

Group Discussion

- What are the challenges of this option?
- What is positive's about this option?
- What additional information do you need?
- Any questions for the specialists?

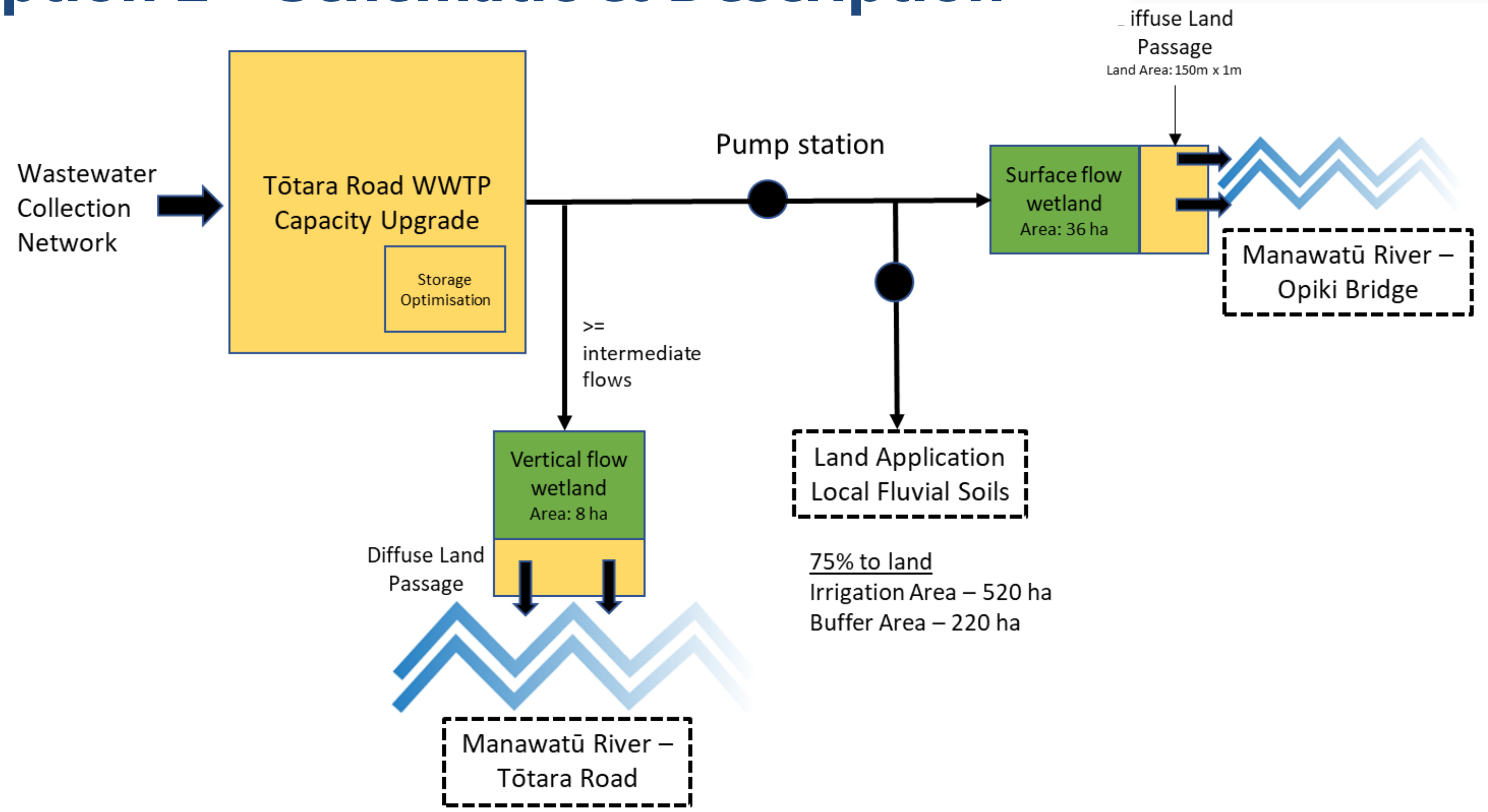
Lunch Break

12.30 – 1.15pm

Option 2 - Two River Discharge Points

30 mins

Option 2 – Schematic & Description



Option 2 - Scoring

SPECIALIST SCORING

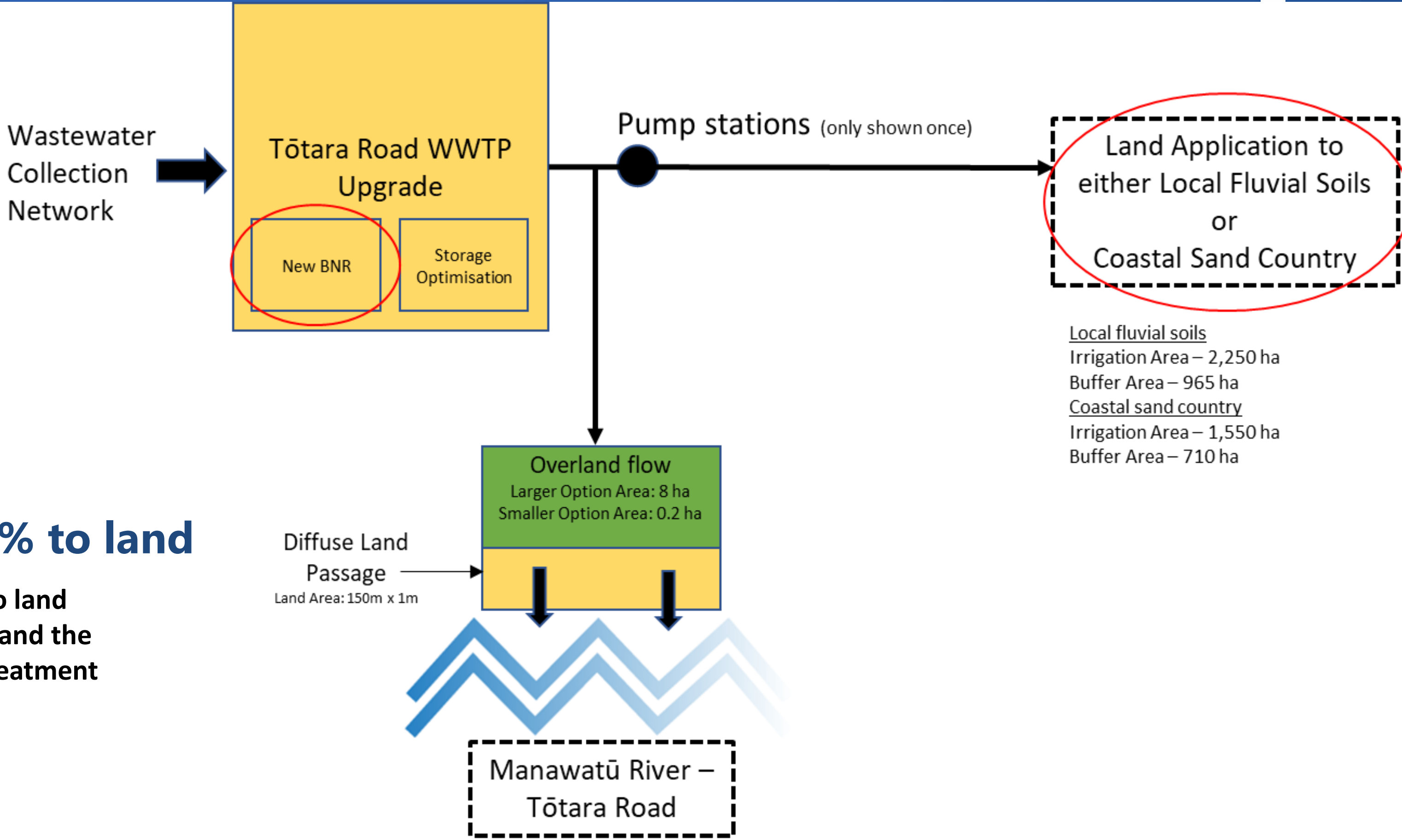
OPTION	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
Two river discharge points, and a small % to land	4	4	1	1	2.7	3	3.5	2.5	21.7

Option 3 - 97% to land

30 mins

Option 3 – 97% to land

Variation relates to land application location and the associated level of treatment



Option 3 - Scoring

SPECIALIST SCORING

OPTION VARIANTS	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
97 % applied to an inland land application site and a discharge to river in exceptional circumstances	3	3.5	4	1	2.4	3	3	2	21.9
97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	4	4	3	1	1.1	3	3	3	22.1

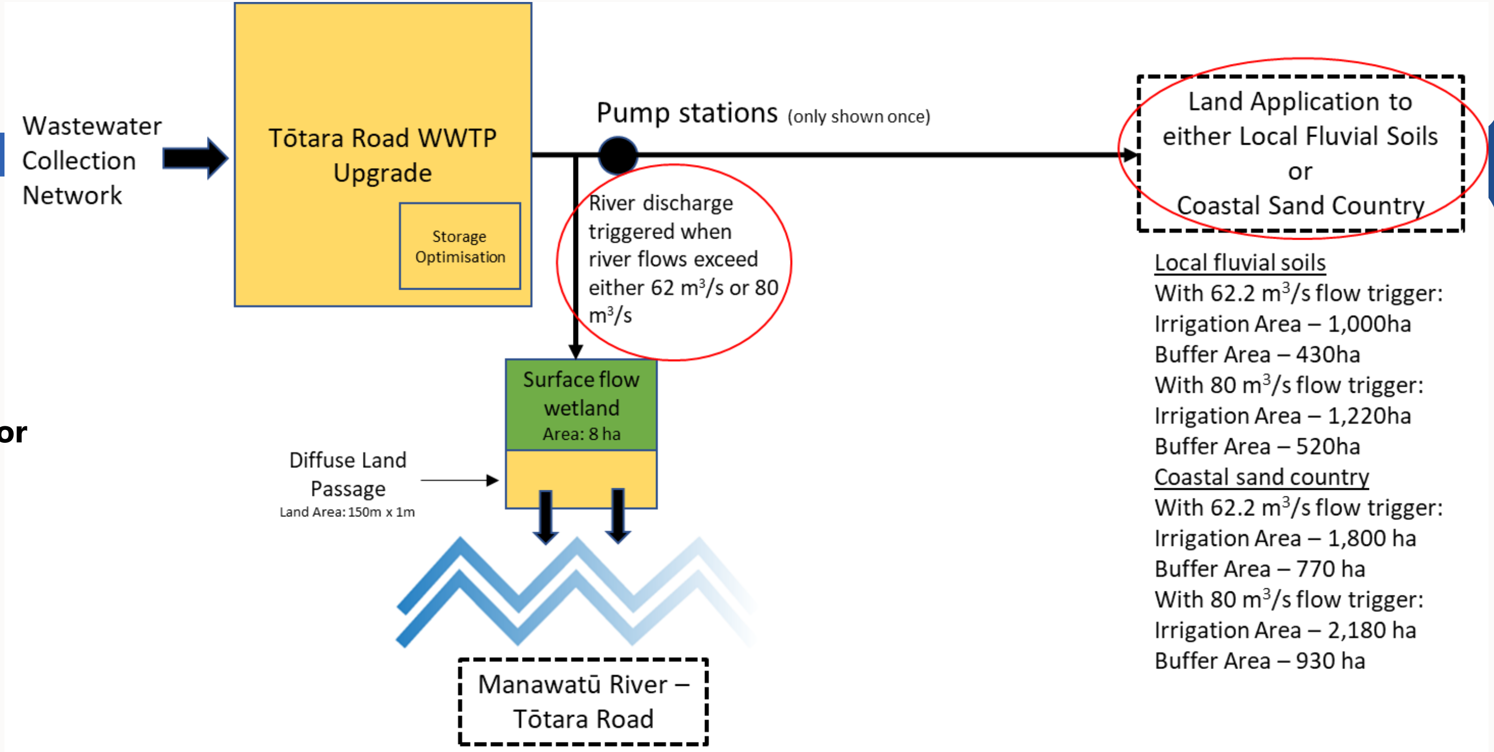
PALMERSTON NORTH
NATURE CALLS

Option 4 - 45 or 55 % applied to land

30 mins

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Option 4 – 45 or 55 % applied to land

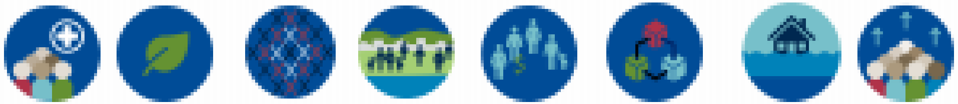


Variation relates to:

1. **location of land application and**
2. **the flow trigger for river discharge**

Option 4 - Scoring

SPECIALIST SCORING



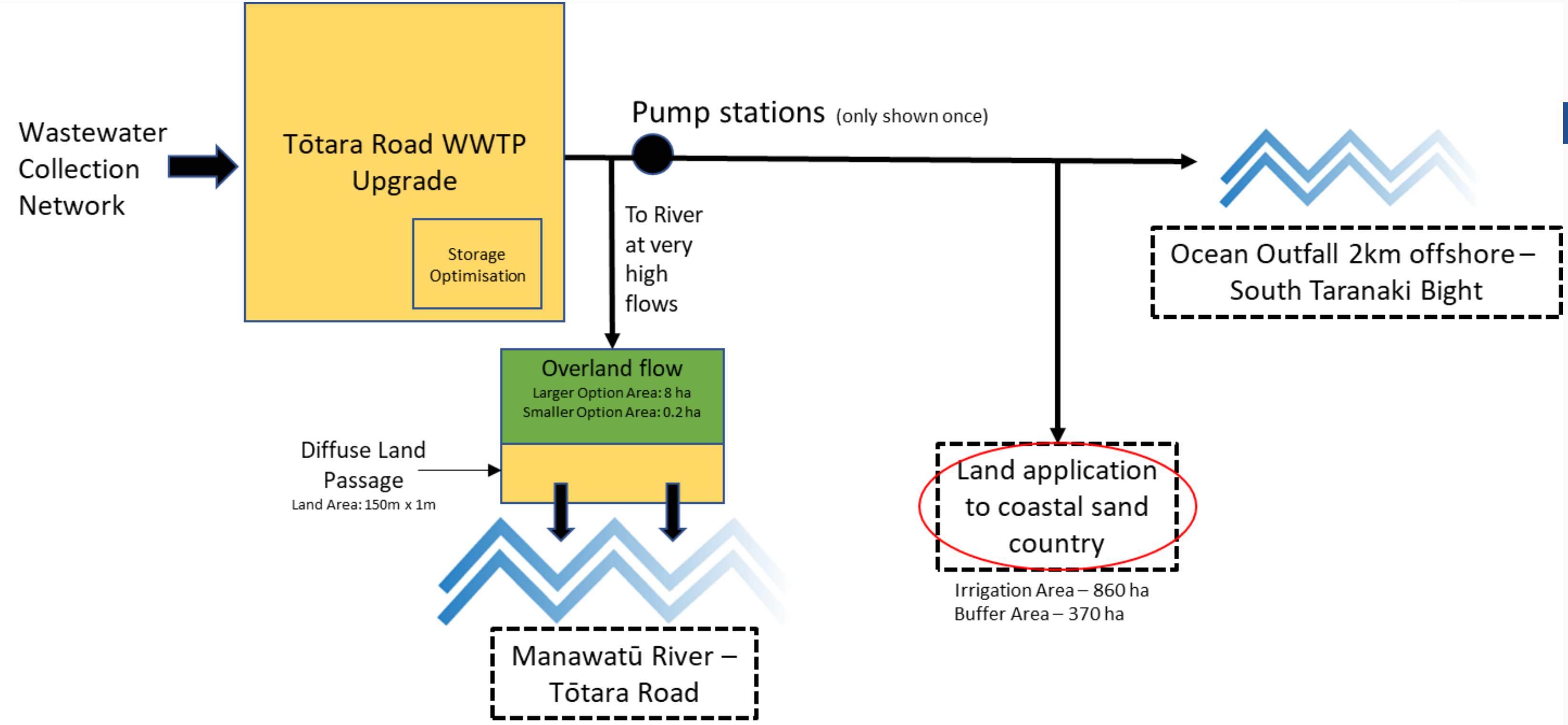
OPTION VARIANTS	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
45 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	2	1	3.0	3	3.5	3	22.5
55 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	3	1	2.8	3	3.5	3	23.3
45 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	1	2.5	3	2.5	2	18
55 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	1	2.2	3	2.5	2	17.7

Option 6 - Ocean

30 mins

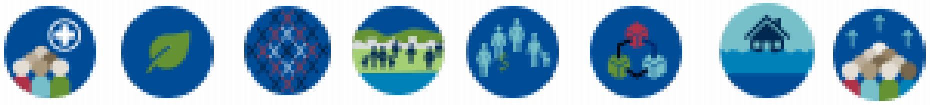
Option 6 – Ocean

Variation relates to whether this option includes land application



Option 6 - Scoring

SPECIALIST SCORING



OPTION VARIANTS	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
Ocean discharge, with a small % to land	2.5	4.5	1	1	1.9	2.5	3	4	20.4
Ocean discharge	5	4	1	2	2.4	2.5	3.5	4	24.4

Afternoon Tea

3.15 – 3.30pm

Option Scoring Consolidation

Melaina Voss - 30 mins

PALMERSTON NORTH NATURE CALLS

A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Comparative Option Scoring

Options	Public health	Natural environment	Māori cultural values	Social & community	Financial implications	Technology & infrastructure	Resilience	Growth & economic development	Combined score
1: R2(b)	4	3	1	2	2.8	4	4	2	22.8
	2.5	3.5	1	1	2.1	4	3	2.5	19.6
2: Dual R + L	4	4	1	1	2.7	3	3.5	2.5	21.7
3: L+R (a) & (b)	3	3.5	4	1	2.4	3	3	2	21.9
	4	4	3	1	1.1	3	3	3	22.1
4: L + R (d) & (e)	3	4	2	1	3	3	3.5	3	22.5
	3	4	3	1	2.8	3	3.5	3	23.3
	2	3	2	1	2.5	3	2.5	2	18
	2	3	2	1	2.2	3	2.5	2	17.7
6: Ocean	2.5	4.5	1	1	1.9	2.5	3	4	20.4
	5	4	1	2	2.4	2.5	3.5	4	24.4

Assessment Criteria Weighting

Melaina Voss- 55 mins

Weighting or No Weighting?

Should assessment criteria weighting be applied??

- **Yes?**
- **No?**
- **Undecided?**

Group Discussion - Weighting or No Weighting – Which Criteria

YES - assessment criteria weighting should be applied??

- **Discuss and record why? +**
- **Which assessment criteria more important?**
- **What weighting could be applied?**

NO - assessment criteria weighting should be applied??

- **Discuss and record why?**

Undecided? – Join a group until you decided

Step 1 - All groups record thoughts onto post it notes and group on Butchers paper
Step 2 - Collate all Yes/No outputs onto wall and summarise

Weighting Sensitivity Testing

- What weighting scenarios would you like to see in Day 2?
- Scenarios will be applied overnight?

Day 1 - Summary

We have collectively:

- Been briefed by the Assessment Specialists
- Considered each option and the criteria assessment
- Considered the benefits/non benefits of weighting the criteria
- Agreed what you would like to see in day 2 for weighting sensitivity testing

Agenda for Day 2 – Trade off between the options

Weighting Sensitivity Testing

- Weighted option scoring results
- Lock in the weighting(if any)

Preferred Option(s)

- Can we shortlist a preferred option(s)?

Summary wrap up

- Option story

Next steps

- What further information do we need going forward

Thinking over night

Close from the Mayor

PALMERSTON NORTH NATURE CALLS

Wastewater BPO
Day 2

Collaborative MCA

9th & 10th November

Karakia

PALMERSTON NORTH
NATURE CALLS

Welcome from the Mayor

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

MCA – Workshop Agenda

Sara Dennis - Just Add Lime

5 mins

Agenda for Day 2 – Trade off between the options

Weighting Sensitivity Testing

- Weighted option scoring results
- Lock in the weighting(if any)

Preferred Option(s)

- Can we shortlist a preferred option(s)?

Summary wrap up

- Option story

Next steps

- What further information do we need going forward

Breaks

Morning Tea	10.15 – 10.35
Lunch	12.35 – 1.15
Afternoon Tea	?? – ??

Weighting Sensitivity Testing

Part 1 - Specialists/Workshop Weighting

XXXX

XXXX

Morning Tea

Weighting Sensitivity Testing

Part 2 – Project Teams Weighting

XXXX

XXXX

PALMERSTON NORTH
NATURE CALLS

Weighting Sensitivity Testing

Part 3 – Comparing the Differences

XXXX

XXXX

Lunch

Preferred Option(s)

XXXX

XXXX

PALMERSTON NORTH
NATURE CALLS

Afternoon Tea

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

PALMERSTON NORTH NATURE CALLS

Wrap-Up

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

XXX

XXX

PALMERSTON NORTH NATURE CALLS

Wastewater BPO
Day 1

Collaborative MCA

9th & 10th November

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Karakia

PALMERSTON NORTH

NATURE CALLS

Welcome from the Mayor

5 mins

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

MCA – Workshop Agenda

Sara Dennis - Just Add Lime

5 mins

Agenda for Day 1- Gain Insight & shared understanding

Technical specialist

- How they went about scoring specific criteria & why

Understanding the Options

- Consolidated scores from specialist's
- Discuss to collectively understand/further group input
- Build up an integrated story about each option - integrated specialist view

Overall option score variation

- scoring high/low

Collectively agree weighting (if any, will apply overnight)

Refresh MCA scores based on collective inputs/enhanced understanding (if any, will apply overnight)

Breaks

Morning Tea	10.30 – 10.45
Lunch	12.30 – 1.15
Afternoon Tea	3.15 – 3.30

Agenda for Day 2 – Trade off between the options

Weighting Sensitivity Testing

- Weighted option scoring results
- Lock in the weighting(if any)

Preferred Option(s)

- Can we shortlist a preferred option(s)?

Summary wrap up

- Option story

Next steps

- What further information do we need going forward

PALMERSTON NORTH

NATURE CALLS

Introduction

Robert Van Bentum – Transport & Infrastructure Manager

Melaina Voss – BPO Project Manager

10 mins

Wastewater Project Charter Tu-Tohinga

PALMERSTON NORTH

NATURE CALLS

VISION PAE TAWHITI

Management of the City's wastewater which enables growth, protects and enhances the environment and contributes to improving the health and mauri of the Manawatū River.

Ko te whakahaere I te parawai o Papioea, e pai ait e tipu o te taonga, e rauhītia ai te taiao, e piki anō ai te ora me te mauri o Te Awa o Manawatū.

TREATY COMMITMENT TE MANAWA TITIKAHA KI TE TIRITI O WAITANGI

As per National Policy Statement on freshwater, provide for the involvement of iwi and hapū, and to ensure that tāngata whenua values and interests are identif ed and ref ected in the management of fresh water including associated ecosystems, and decision-making regarding freshwater planning;

PROJECT OBJECTIVES PAE TATA

A best practicable option wastewater management solution that is developed in partnership with Rangitāne o Manawatū which:

1. Protects public health and minimises public health risks.
2. Minimises adverse environmental ef ects on air, land and water;
3. Is sustainable, enduring, and resilient;
4. Contributes to improving the health and mauri of the Manawatū River;
5. Takes an integrated approach to the management of the Manawatū River Catchment including understanding cumulative ef ects;
6. Enhances peoples use and enjoyment of the Manawatū River
7. Is af ordable and cost ef ective;
8. Minimises whole of life carbon emissions and optimises resource recovery;
9. Is innovative while being evidence based;
10. Facilitates long term growth and economic development
11. Is developed with the active engagement of the community and key stakeholders

VALUES UARA

Decision making processes followed during the project shall be:

a. Evidence based;
b. Ef cient and timely;
c. Undertaken to meet the requirements of the current resource consent (in terms of the scope of the BPO review); and
d. Consistent with the National Policy Statement for Freshwater Management, the National Policy Statement on Urban Development Capacity and the One Plan.
e. PNCC and Horizons work collaboratively in developing the best practicable option for the management of the City's wastewater.

PROJECT STRUCTURE TE HANGA O TE KAUPAPA

The current roles and responsibilities of the groups associated with the project are summarised in the infographic to the right –

PALMERSTON NORTH CITY COUNCIL
(decision making and funding body)

Project Steering Group *(provides governance, oversight and direction to the BPO Review Project)*
Membership Elected Members | Rangitane Reps | Council Of cers
Advisors BPO PM | Professional Advisors | Council Staf

ENGAGEMENT AND COMMUNICATION

Public and Community
Technical Advisory Group
Special Interest Groups – Iwi

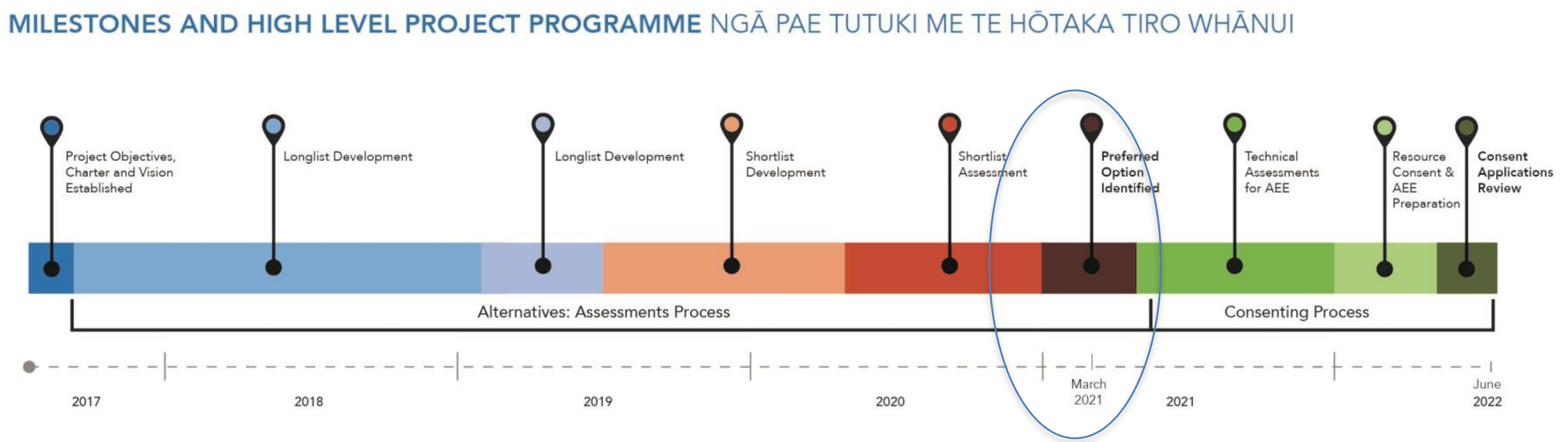
STAKEHOLDER ENGAGEMENT TE WHAI WĀHITANGA MAI O TE HUNGA WHAIPĀNGA

This section will outline the focus and broad approach to community and stakeholder engagement. A draft Communication and Engagement Plan is being prepared.

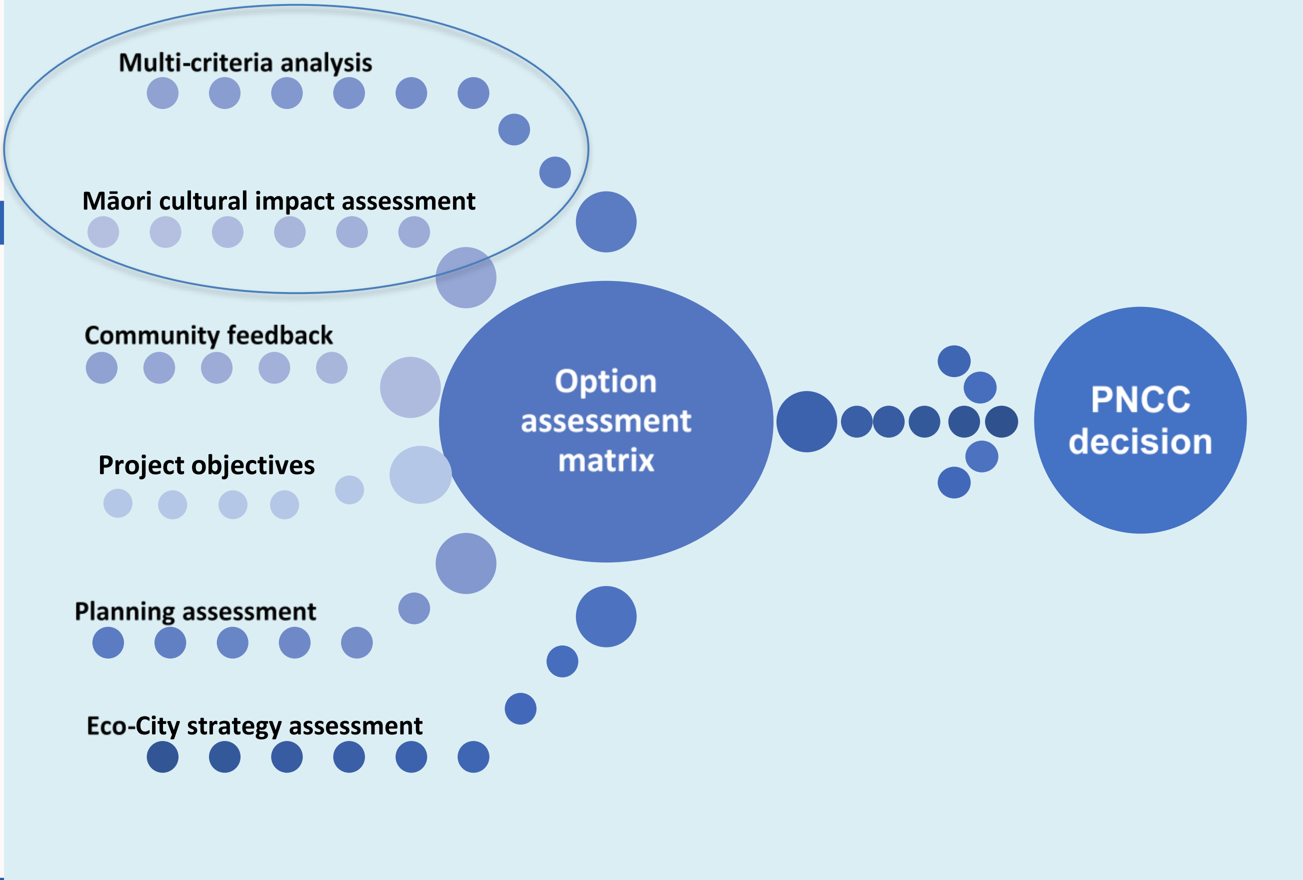
What we have achieved so far

- Contextual review and understanding of our future growth and infrastructure needs
- Development of longlist options, evaluation and refinement to a shortlist
- Investigation into potential receiving environments and the environmental and environmental legislation constraints
- Closely working with Horizons Regional Council
- Community and stakeholder engagement
- Closely working with Rangitane o Manawatu along the way. Now working with neighbouring Iwi.

Where we are in our decision-making process

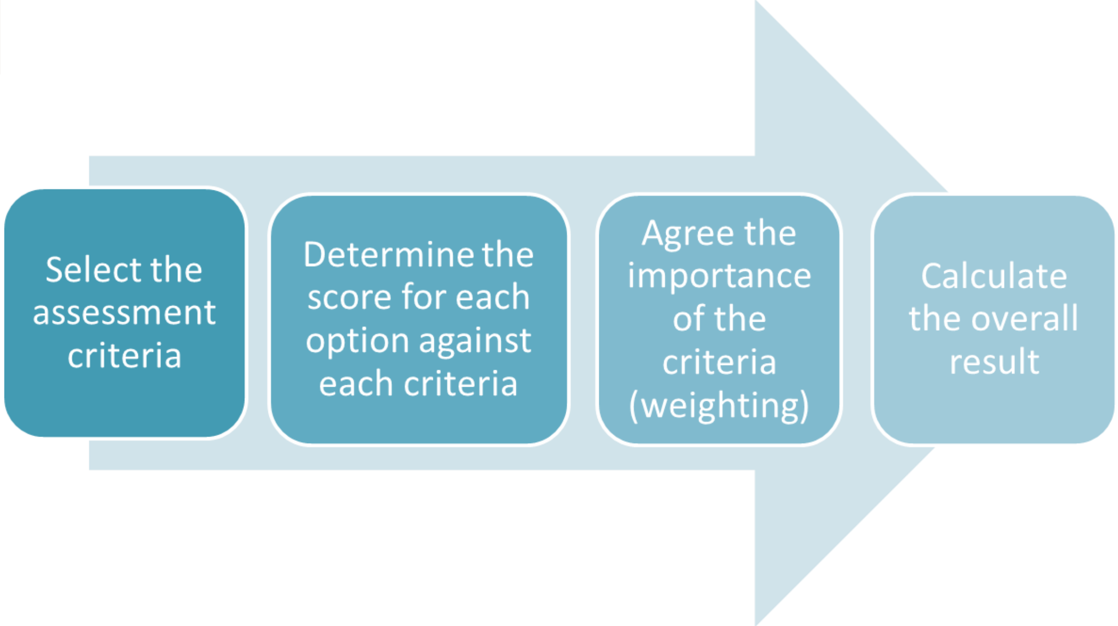


Overall Approach



Multi-Criteria Analysis (MCA)

- Systematic way of comparing options using a range of criteria
- For complex problems it provides a **relatively** simple way of comparing their merits
- MCA does have limitations that need to be kept in mind - inherent ‘subjectivity’ and unconscious bias of the participants – sensitivity testing
- Use a collaborative workshop process, involving partners and stakeholders



Specialist Assessment

Sara Dennis – 2 hours with

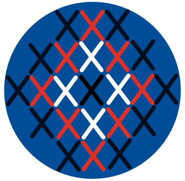
8 Specialists 15 mins each

Cultural Context

Assessment Criteria

Public Health

Degree of public exposure to health risks in treated wastewater (including through land application or re-use options)



Māori Cultural Values

Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Māori, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga

Financial Implications

Comparative capital, operational, whole of life costs of the option. Where relevant to the option, assessment of this criterion includes consideration of land acquisition costs, capital gains and product net revenue.

Natural Environment

Potential adverse environmental effects on the receiving environment (including the Manawatū River), particularly in relation to water quality (including the matters listed in s107 (1) (c) to (g)), soils, aquatic ecology and terrestrial ecology

Resilience

Degree to which the option is resilient to natural hazards and climate change and offers operational resilience.

Growth & Economic Development

Will the option support the population and economic growth anticipated for the City by Council?

Social & Community Considerations

Significance of potential social effects based on the gravity, distributive equity, the need for land acquisition and degree of permanence of land use change, and public support for the option

Technology & Infrastructure

Degree to which the option:

- Uses reliable & proven technology
- Can be staged
- Able to be constructed
- Constructed within app timeframe
- Allows resource recovery/beneficial re-use

PALMERSTON NORTH

NATURE CALLS

Jim Bradley – Stantec
Brett Munro – MidCentral DHB
Stephen Palmer – Regional Public Health

Public Health

Degree of public exposure to health risks in treated wastewater (including through land application or re-use options)

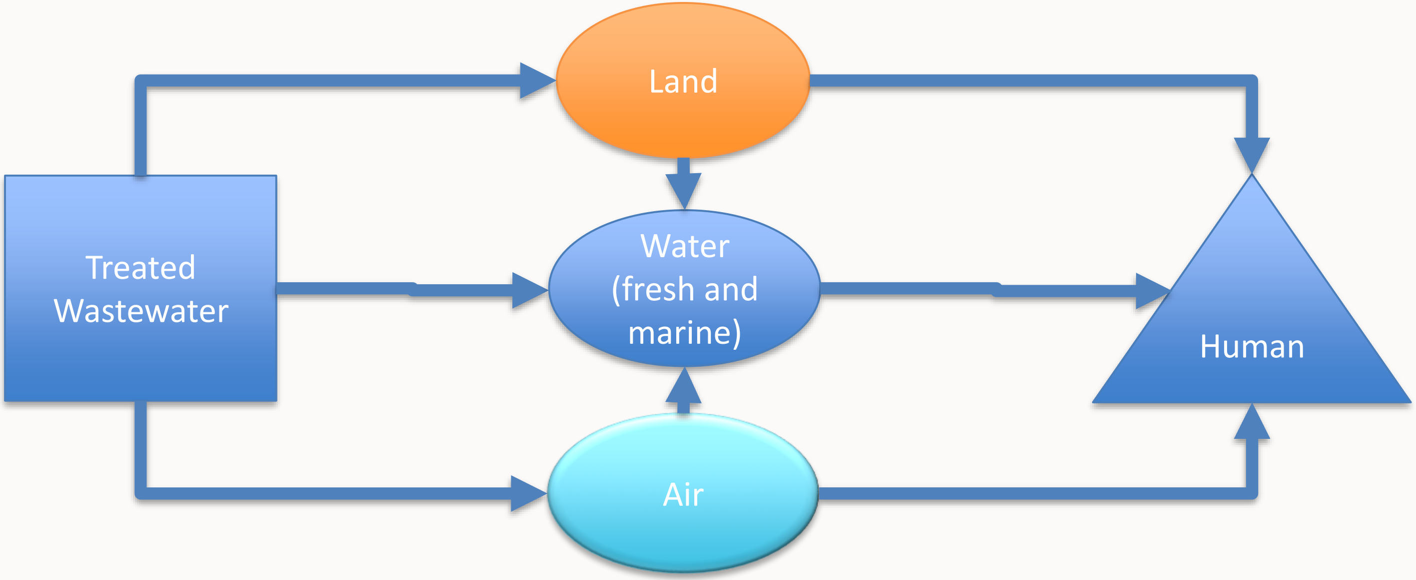
Public Health

Methodology is based on the potential for Public Health Risk from human contact with the treated wastewater

Uses a conceptual exposure pathway methodology

Recommended criteria based on number of identified critical exposure pathways:
- **differentiates between options**
- **focuses on critical pathways**
- **reflects the potential difficulty in managing the risk to public health resulting from the treated wastewater**

Public Health – Conceptual Exposure Pathways



Public Health

Criteria Selection

1 Low	2 Low - medium	3 medium	4 Medium - high	5 High
Catastrophic: health effects affect a larger group of people across a wider area, which requires a larger scale of public health response with contact tracing. All persons affected only experience a major illness, which is likely to be dangerous to sensitive members of the community	Major: health effects affect a larger group of people across a wider area, which requires a larger scale of public health response with contact tracing. All persons affected only experience a moderate illness, which may be dangerous to sensitive members of the community	Moderate: health effects affect a larger group of people across a wider area, which requires a larger scale of public health response with contact tracing. All persons affected only experience a minor illness	Minor: health effects are limited to a single person, single household or single group of people who can be readily identified and contacted by the public health authorities and the consent holder for appropriate advice who experience a minor illness	Insignificant: illness resulting from the treated wastewater discharge is indiscernible above the normal background level of illness in the community.

PALMERSTON NORTH

NATURE CALLS

Keith Hamill – River Lake
Olivier Ausseil – Aquanet
Aslan Perwick – PDP

Natural Environment

Potential adverse environmental effects on the receiving environment (including the Manawatū River), particularly in relation to water quality (including the matters listed in s107 (1)(c) to (g)), soils, aquatic ecology and terrestrial ecology

Natural Environment: Key considerations

Rivers and Lakes

- Nutrients to Manawatū causing periphyton growth and exceeding OP targets (used PointSim Model)
- Effects on river less at high flows and downstream of Opiki.
- Risk from land treatment to small streams / lakes (considered N leaching rate cf. current landuse, irrigation area/location)

Coastal

- Near shore zone and benthic habitats near the outfall.

Groundwater & Soils

- N leaching rate, seasonal application, ability to avoid sensitive areas and apply buffer zones.

PALMERSTON NORTH NATURE CALLS

A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Natural Environment Scoring Criteria

Score	Adverse Effect	Description	Example
1	Very High	Major loss or change in baseline conditions.	One Plan (OP) targets regularly exceeded. Risk of chronic toxicity.
2	High	Major change in baseline conditions.	
3	Moderate	Moderate change in baseline but generally acceptable.	OP targets generally met but risk of occasional exceedance. Minor effects on soils.
4	Low	Small shift from baseline.	
5	Very Low	Very slight change from baseline.	Negligible ecological effects. Risk to exceeding OP targets is very low. Negligible to positive effect on GW. Benefits to soils.

Jonathan Proctor – Rangitane
Danielle Harris - Rangitane

Māori Cultural Values

Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Māori, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga

Māori Cultural Values

Context

- The assessment was undertaken by the Rangitāne o Manawatū representatives and Te Ao Turoa staff. Key concepts focused on;
  - Cultural Values
  - Cultural Landscapes
  - Atua
  - Potential Acceptance to our people

- Options discussed in 3-4 half day hui. Values and assessments undertaken in 2 wananga

- Rangitāne o Manawatū also invited neighbouring Iwi Ngati Apa, Muaupoko and Ngati Kauwhata.

Fundamentals

Protection of Rangitāne o Manawatū, Protection of the River, Enhancement for the people and future

Māori Cultural Values

Criteria Selection

Criterion	Description	1	2	3	4	5
Rangitāne Cultural Values	Potential adverse effects on the mauri of natural resources, on kai moana, and on the relationship of Rangitāne o Manawatū, their cultures and traditions, with ancestral lands, water, sites, waahi tapu and other taonga	Destruction of Rangitāne culture, connections and kaitiakitanga. Critical effect on Rangitāne o Manawatū	Significant effect or impact on all aspects of Rangitāne Mana, Toanga, Atua and natural resources	Major impact on all aspects of Rangitāne significant sites and natural resources	Minimal impact on Rangitāne significant sites and natural resources	Minimal to no effect on Rangitāne o Manawatū

Māori Cultural Values

Significance

- The Mana of Rangitāne o Manawatū would be recognised through having the activities contined within in the Manawatū / Rangitāne o Manawatū Rohe
- The Manawatū River is not to be further impacted
- The Coast and its resources are not to be impacted or threatened
- Must be future focused, plan for growth, three waters development – more important than short time cost
- Rangitāne o Manawatū believe the is an error not to make continued improvements in treatment before discharge– strong desire to work towards treating to "drinking water standards"
- Neighbouring Iwi maintain the ability to make their own decisions and contribution.

Julie Boucher – Just Add Lime

Social & Community Considerations

Significance of potential social effects based on the gravity, distributive equity, the need for land acquisition and degree of permanence of land use change, and public support for the option

Social & Community Considerations

Context

- Based on engagement to date
- Not dependent on specific location
- Consideration of distributional impacts
- Accepted methodology

Social & Community Considerations

Criteria Selection

Criteria	Description	Level
Gravity	Option will cause death or adverse health effects that could lead to significant reduction in quality of life and/or longevity and/or continued exposure is generally likely to lead to long term limiting illness or disease	G1
	Infringement in access to: • Basic life necessities (including education, livelihood etc) and/or • Cultural, economic, natural or social infrastructure/assets that have been identified as highly valued by identified groups or subject matter experts • Ecosystem services identified as priority to livelihoods[1], health, safety or culture by identified groups or subject matter experts	G2
	All other impacts	G3
Distributive equity	Waste water treated in PNCC and part of the water discharged into the river and/or part of the water conveyed out of PNCC area so treated water can be applied to land outside the PNCC area	E1
	Waste water treated in PNCC area and all discharge into the river within PNCC or piped to the ocean for discharge	E2
	Waste water treated in PNCC area and treated water applied to land wholly within PNCC area	E3

Social & Community Considerations

Criteria Selection cont

Criteria	Description	Level
Need for land acquisition and degree of permanence of land use change	Yes with permanent land/water use changes	PC1
	Yes with temporary land/water use changes (able to be reversed) or no need for acquisition	PC2
Public support for the option[2]	Little or no support based on feedback from the public (<25% of feedback identified as most preferred)	S1
	Feedback doesn't provide a clear indication of support (25 – 50% feedback identified as most preferred)	S2
	High level of support based on feedback from the public (>50% of feedback identified as most preferred)	S3

Social & Community Considerations

Significance

The significance of potential social effects is then calculated using the following table

Specification of conditions for assigning significance	Rating	Score
G1 (regardless of any other criteria), or G2 and PC1 and S1/S2 (regardless of distributive equity)	Severe	1
G2 and PC1 and S3 (regardless of distributive equity), or G2 and PC2 and E1/E2 and S1/S2	Major	2
G2 and PC2 and E3 (regardless of support), G3 and PC1 (regardless of extent and support) or G3 and E1/E2 and R1/R2 (regardless of support)	Moderate	3
G3 and E1/E2 and PC2 and S3	Minor	4
G3 and E3 and PC2 and S3	Insignificant	5

PALMERSTON NORTH
NATURE CALLS

Anna Bridgeman - Stantec

Resilience

Degree to which the option is resilient to natural hazards and climate change and offers operational resilience.

Resilience Categories

Natural Hazards

- Risks of earthquakes
- Land movement and erosion
- Flooding
- Storm surge/tsunami

Climate Change and Adaptation

- High intensity rainfall peaks
- Prolonged wet weather periods
- Prolonged dry periods
- Prolonged dry periods resulting in an increase of low flows in the Manawatū River flows,
    - increased levels of treatment (phosphorous and nitrogen removal for greater periods of time)
- Sea level rise

Resilience Criterion

Method of Assessment

- Degree to which option is resilient to natural hazards & climate change – from LOW to HIGH
- Comparative comparison between the options
- Overall score given based on the average of sub-category scores

Criterion	Description	1	2	3	4	5
Resilience	Degree to which the option is resilient to • natural hazards • climate change	Low degree of resilience	Low – Medium degree of resilience	Medium degree of resilience	Medium – High degree of resilience	High degree of resilience

PALMERSTON NORTH
NATURE CALLS

Melaina Voss – Stantec
Richard Peterson - Stantec

Growth & Economic Development

Will the option support the population and economic growth anticipated for the City by Council?

Growth & Economic Development

Context

- Based on growth projects for the next 35 years – 50 years
- No specific sites identified
- Considering Councils growth and economic development strategies as well as the regions plans (known)
- Consideration of capacity to provide a sub-regional scheme ie additional flows and loads as well as proximity to connect other wastewater systems

Growth & Economic Development

Criteria Selection

Criterion	Description	1	2	3	4	5
Growth and Economic Development	The degree to which the options will: • Support the population and economic growth anticipated for the City by Council? • Support / restrict further up-scaling to accommodate a sub-regional scheme?	Low degree	Low – Medium degree	Medium degree	Medium – High degree	High degree

Morning Tea

10.30 – 10.45am

Anna Bridgeman - Stantec

Technology & Infrastructure

Degree to which the option:

- Uses reliable & proven technology
- Can be staged
- Able to be constructed
- Constructed within app timeframe
- Allows resource recovery/beneficial re-use

Technology & Infrastructure Categories

- Can be Staged
- Is able to be constructed and operational within 5 years of the commencement of the consent
- Allows for resource recovery / beneficial re-use
- Infrastructure can be up-scaled, prior to and post initial construction, to accommodate a sub-regional scheme
- Involves Operational/Technical Complexity
- Involves Operational Risk

Criteria Selection

- Each of the six sub-criteria were scored with regards to how well the option aligned with that sub-criteria.
  - LOW to HIGH for alignment with the first four sub-criteria
  - HIGH to LOW for Operational Complexity & Risk
- The overall draft score is an average of these six scores, rounded to the nearest 0.5
- Each sub-criteria given equal weighting.
- Average has been used rather than the lowest score as it is not believed that any one of these sub-criteria is the governing factor in the selection of the BPO.

Criterion	Description	1	2	3	4	5
Technology and Infrastructure	Degree to which the option: • can be staged • is able to be constructed and operational within 5 years of the commencement of the consent • allows for resource recovery / beneficial re-use • infrastructure can be up-scaled, prior to and post initial construction, to accommodate a sub-regional scheme • involves Operational Complexity • involves Operational Risk	Low degree of alignment with sub-criteria and/or High Operational Complexity and Risk	Low – Medium degree of alignment with sub-criteria and/or Medium-High Operational Complexity and Risk	Medium degree of alignment with sub-criteria and/or Medium Operational Complexity and Risk	Medium – High degree of alignment with sub-criteria and/or Low-Medium Operational Complexity and Risk	High degree of alignment with sub-criteria and/or Low Operational Complexity and Risk

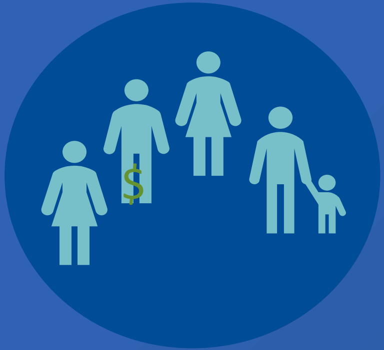
Technology & Infrastructure Criterion

Method of Assessment

- Each of the six sub-criteria were scored with regards to how well the option aligned with that sub-criteria.
    - LOW to HIGH for alignment with the first four sub-criteria
    - HIGH to LOW for Operational Complexity & Risk
- The overall draft score is an average of these six scores, rounded to the nearest 0.5
- Each sub-criteria given equal weighting.
- Average has been used rather than the lowest score as it is not believed that any one of these sub-criteria is the governing factor in the selection of the BPO.

PALMERSTON NORTH
NATURE CALLS

Anna Bridgeman - Stantec



Financial Implications

Comparative capital, operational, whole of life costs of the option. Where relevant to the option, assessment of this criterion includes consideration of land acquisition costs, capital gains and product net revenue.

Financial Implications Comparative Assessment

Methodology

- **Step 1** – Development of capital cost and operational and maintenance cost for each component

- **Step 2** – NPV assessment using Capital Cost and OPEX estimates
  - 35 year NPV from 2025
  - 6% discount rate
- **Step 3** – Sub-criteria of Capital, O&M and NPV given a weighting
- **Step 4** – Sub-criteria score for Option X = ((1 – (cost of option X / highest cost)) x 4) +1
- **Step 5** – Overall score = Combination of Sub-criteria scores x weighting

Financial Implications Comparative Assessment

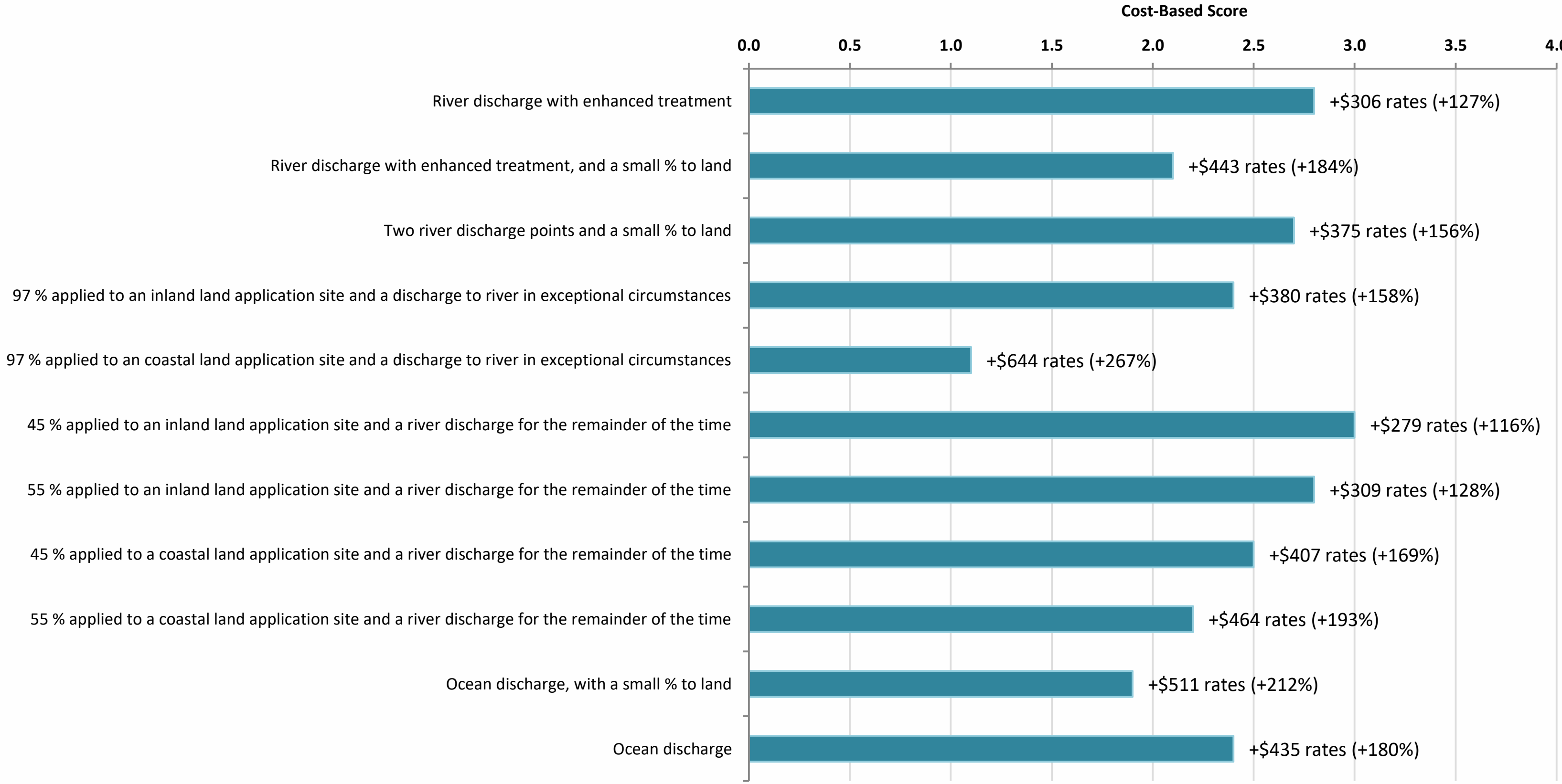
Sensitivity

- **Discount Rate**
  - 6% discount rate has been used through for the option development in the longlist and shortlist phases.
  - Treasury now recommends a 5% discount rate for infrastructure projects
  - Changing the discount rate to 4% and 8% increased or decreased the NPV between 3 - 10% higher and 2 - 7% lower respectively for the options,
    - greatest change 'River with enhanced treatment options'.
    - The level of change dependent on operational and maintenance costs and the return received from crops/forestry for the option.

- **Sub-Criteria Weighting**
  - Initial weighting of 37%, 30% and 33% for cost, O&M and NPV respectively
  - Changing this weighting did not change the top four – some movement between them, but no change overall

PALMERSTON NORTH NATURE CALLS

A FRESH LOOK AT HOW WE MANAGE WASTEWATER



PALMERSTON NORTH
NATURE CALLS

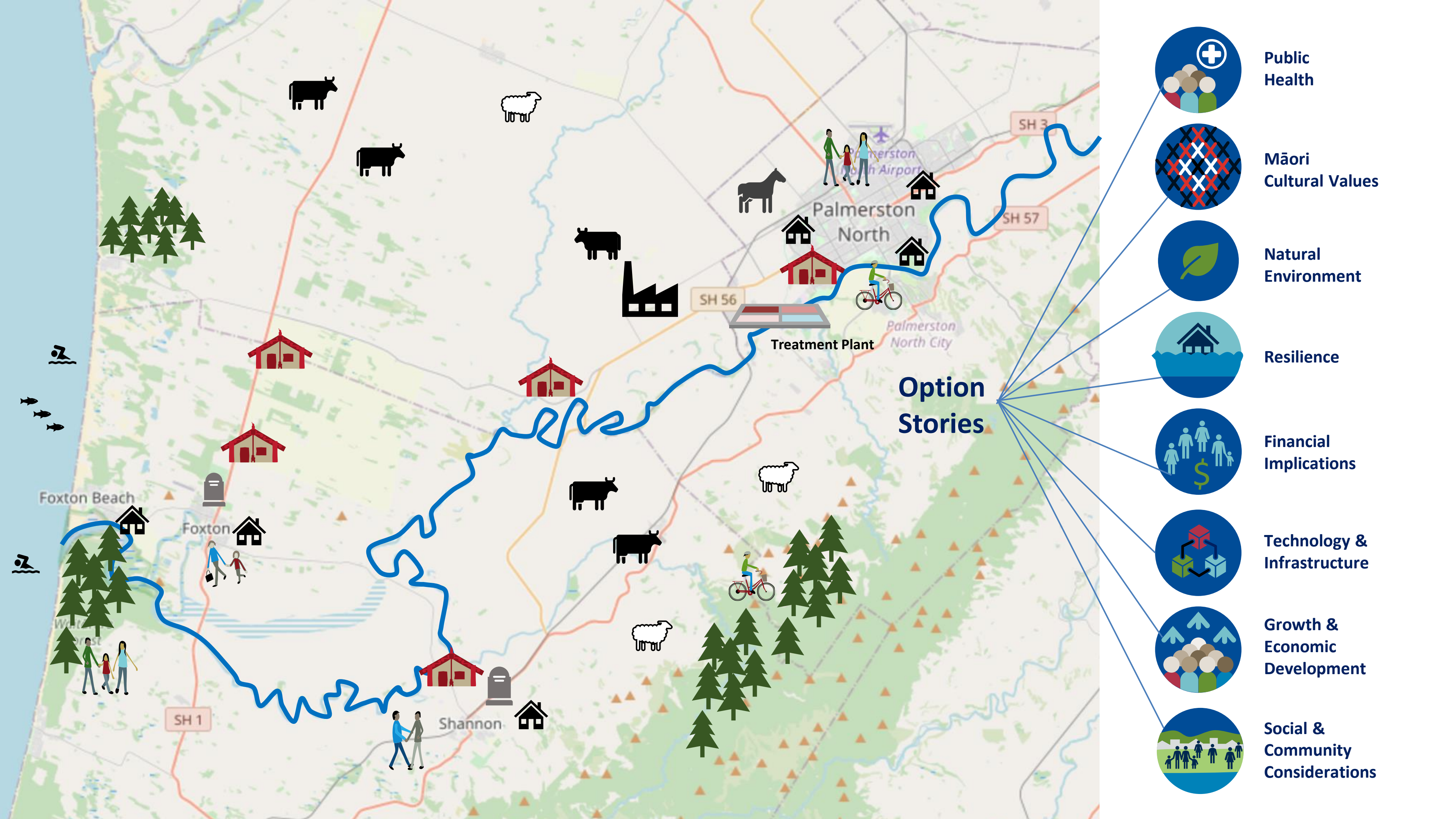
Understanding the options

Robert Van Bentum – Transport & Infrastructure Manager

Melaina Voss – BPO Project Manager

2 ½ hours

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

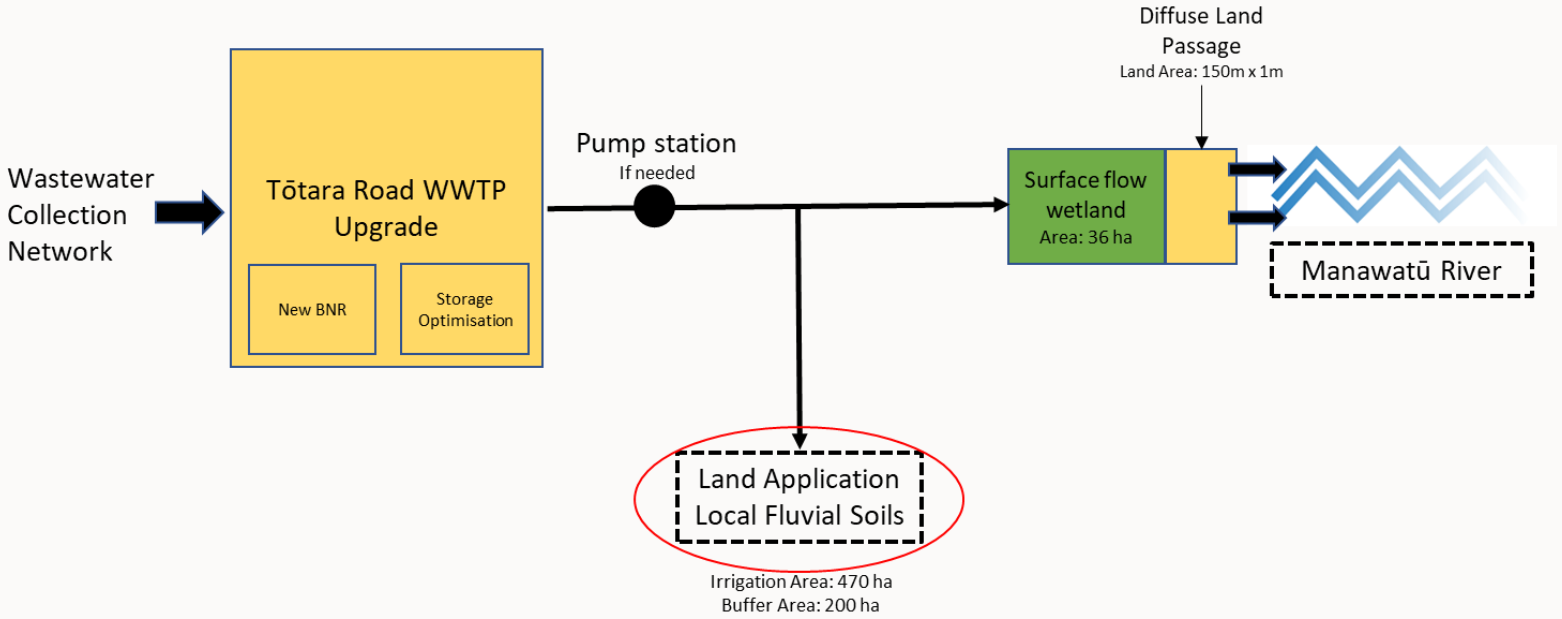


Option Stories
Public Health
Māori Cultural Values
Natural Environment
Resilience
Financial Implications
Technology & Infrastructure
Growth & Economic Development
Social & Community Considerations
Treatment Plant
Palmerston North
Palmerston North City
Foxton Beach
Foxton
Shannon
SH 3
SH 57
SH 56
SH 1

Option 1 - River discharge with enhanced treatment

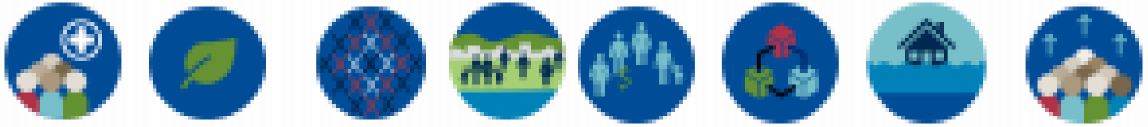
30 mins

Option 1 – Schematic & Description



Option 1 - Scoring

SPECIALIST SCORING



OPTION VARIANTS	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
River discharge with enhanced treatment	4	3	1	2	2.8	4	4	2	22.8
River discharge with enhanced treatment, and a small % to land	2.5	3.5	1	1	2.1	4	3	2.5	19.6

Group Discussion

- What are the challenges of this option?
- What is positive's about this option?
- What additional information do you need?
- Any questions for the specialists?

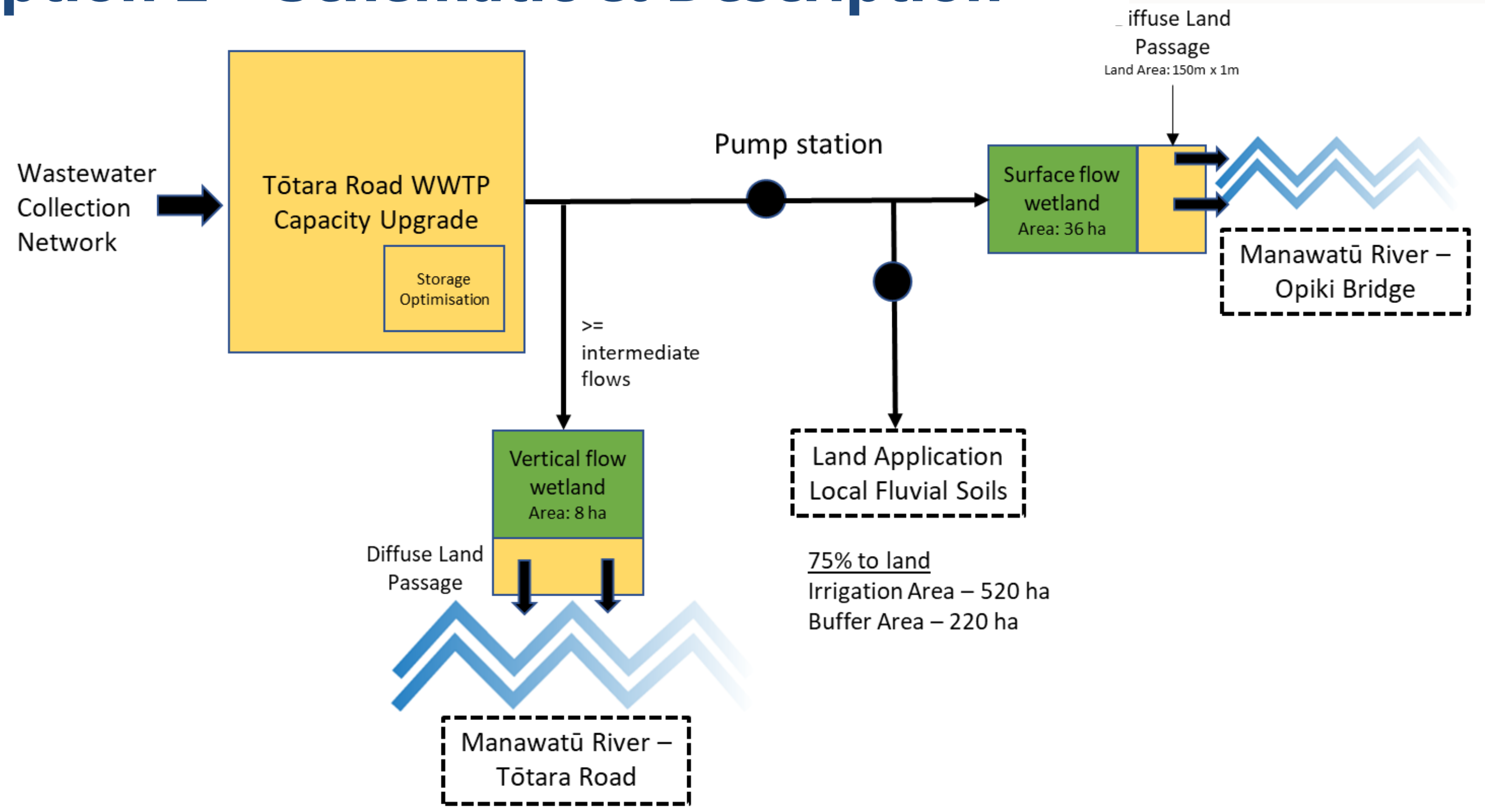
Lunch Break

12.30 – 1.15pm

Option 2 - Two River Discharge Points

30 mins

Option 2 – Schematic & Description



Option 2 - Scoring

SPECIALIST SCORING

OPTION	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
Two river discharge points, and a small % to land	4	4	1	1	2.7	3	3.5	2.5	21.7

PALMERSTON NORTH NATURE CALLS

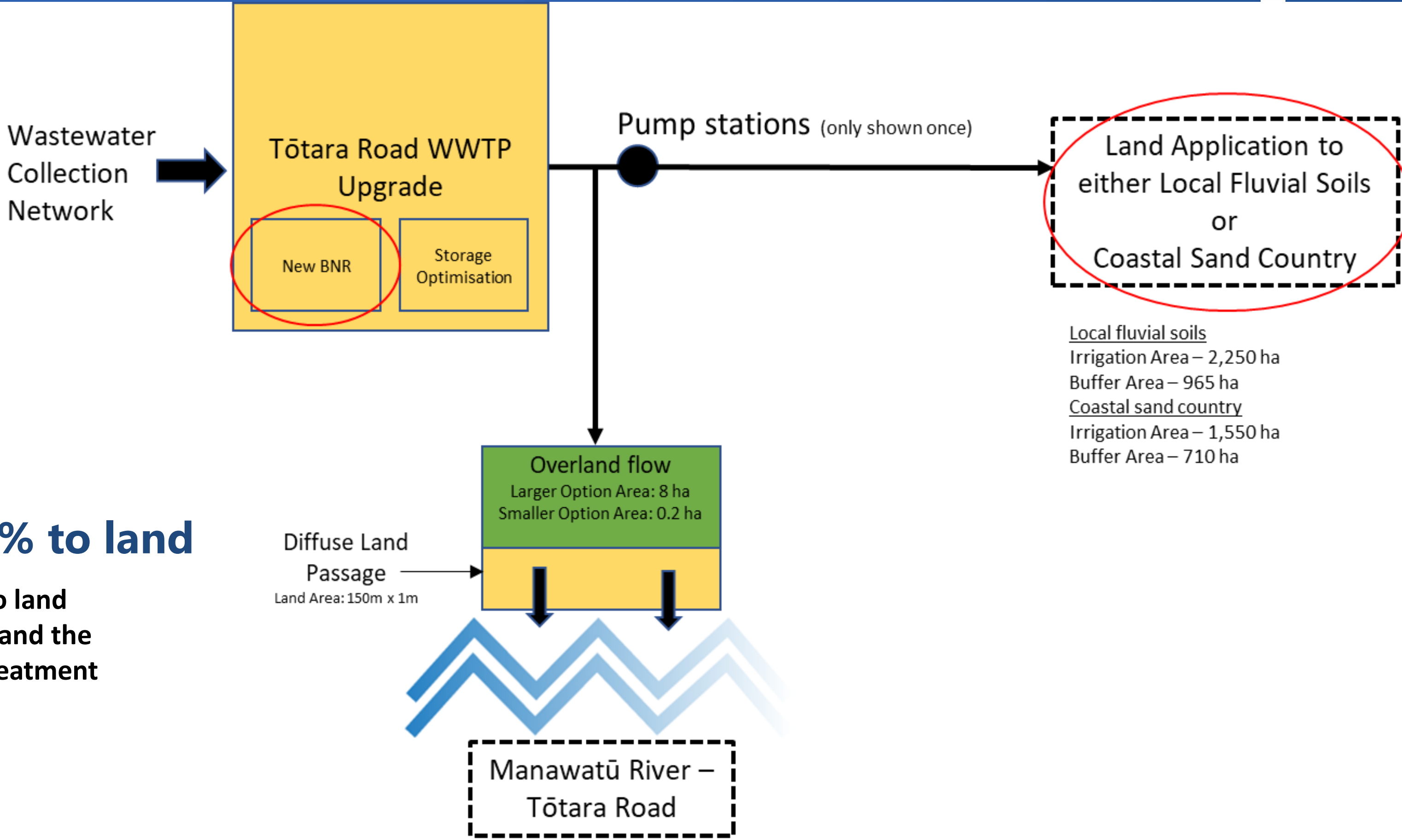
Option 3 - 97% to land

30 mins

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Option 3 – 97% to land

Variation relates to land application location and the associated level of treatment



Option 3 - Scoring

SPECIALIST SCORING

OPTION VARIANTS	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
97 % applied to an inland land application site and a discharge to river in exceptional circumstances	3	3.5	4	1	2.4	3	3	2	21.9
97 % applied to a coastal land application site and a discharge to river in exceptional circumstances	4	4	3	1	1.1	3	3	3	22.1

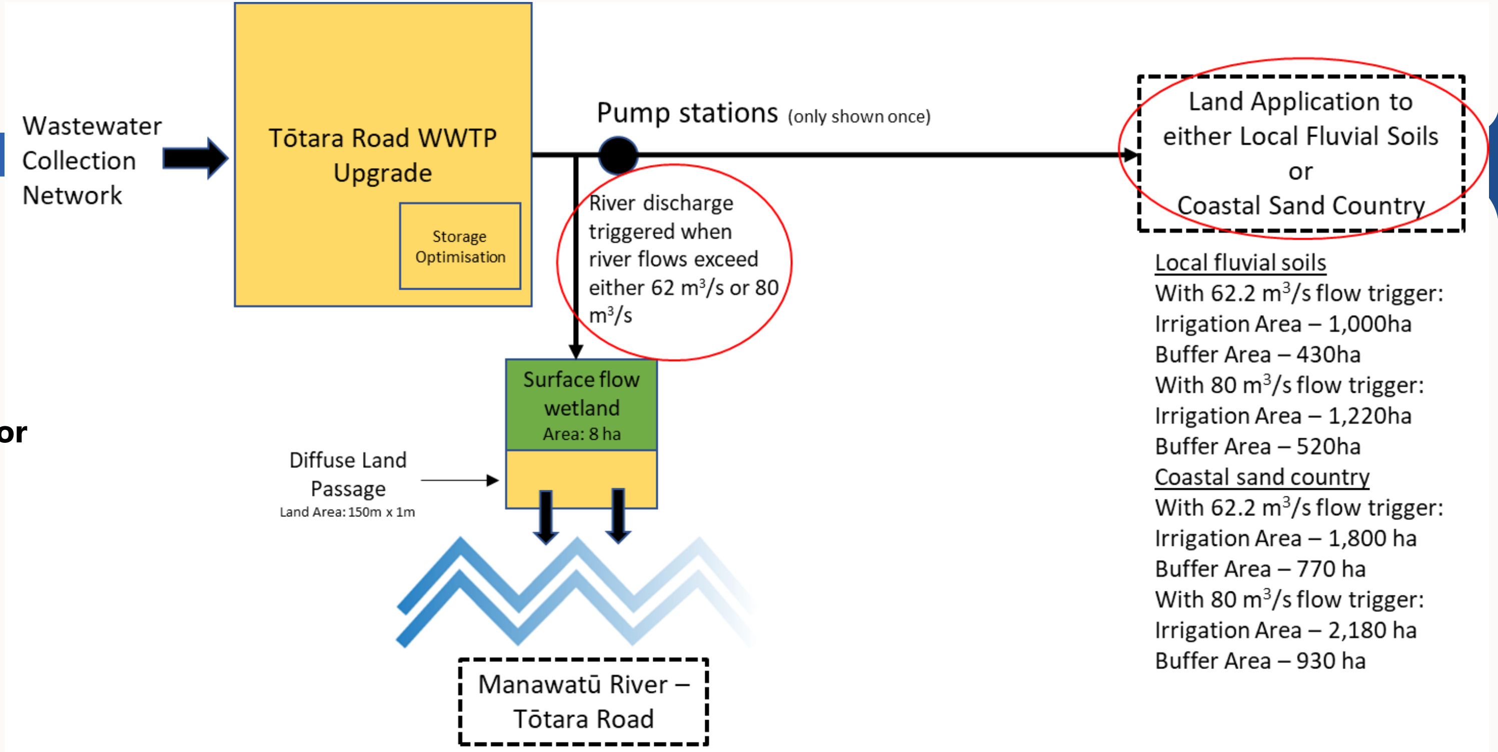
Option 4 - 45 or 55 % applied to land

30 mins

Option 4 – 45 or 55 % applied to land

Variation relates to:

1. **location of land application and**
2. **the flow trigger for river discharge**



Option 4 - Scoring

SPECIALIST SCORING

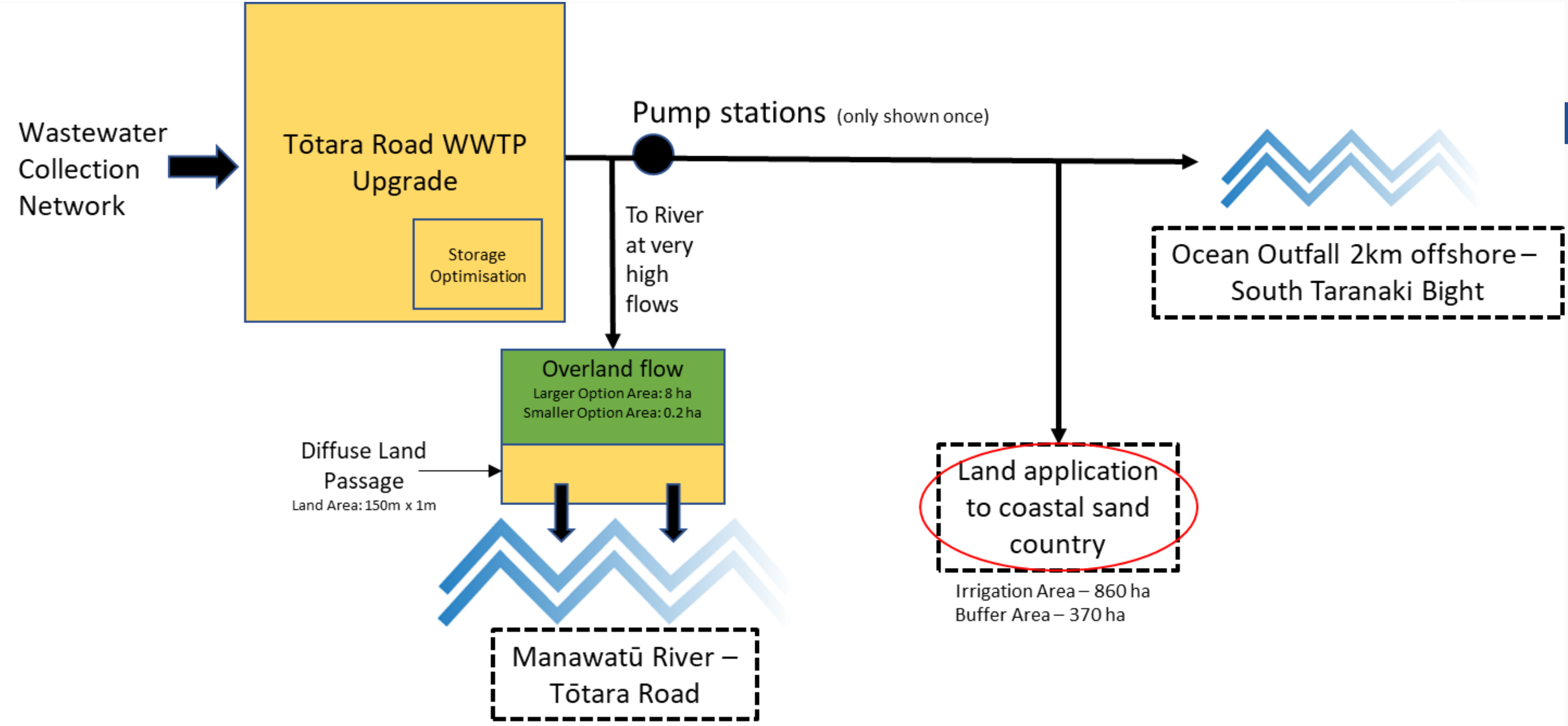
OPTION VARIANTS	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
45 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	2	1	3.0	3	3.5	3	22.5
55 % applied to an inland land application site and a river discharge for the remainder of the time	3	4	3	1	2.8	3	3.5	3	23.3
45 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	1	2.5	3	2.5	2	18
55 % applied to a coastal land application site and a river discharge for the remainder of the time	2	3	2	1	2.2	3	2.5	2	17.7

Option 6 - Ocean

30 mins

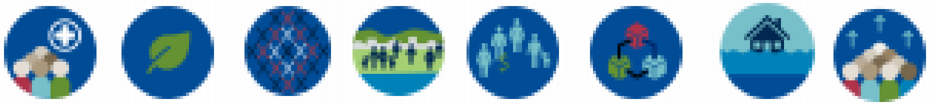
Option 6 – Ocean

Variation relates to whether this option includes land application



Option 6 - Scoring

SPECIALIST SCORING



OPTION VARIANTS	PUBLIC HEALTH	ENVIRONMENT	MĀORI CULTURAL VALUES	SOCIAL & COMMUNITY	FINANCIAL IMPLICATIONS	INFRASTRUCTURE	RESILIENCE	GROWTH & ECONOMIC DEVELOPMENT	UNWEIGHTED TOTAL SCORE
Ocean discharge, with a small % to land	2.5	4.5	1	1	1.9	2.5	3	4	20.4
Ocean discharge	5	4	1	2	2.4	2.5	3.5	4	24.4

Afternoon Tea

3.15 – 3.30pm

PALMERSTON NORTH
NATURE CALLS

Option Scoring Consolidation

Melaina Voss - 30 mins

Comparative Option Scoring

Options	Public health	Natural environment	Māori cultural values	Social & community	Financial implications	Technology & infrastructure	Resilience	Growth & economic development	Combined score
1: R2(b)	4	3	1	2	2.8	4	4	2	22.8
	2.5	3.5	1	1	2.1	4	3	2.5	19.6
2: Dual R + L	4	4	1	1	2.7	3	3.5	2.5	21.7
3: L+R (a) & (b)	3	3.5	4	1	2.4	3	3	2	21.9
	4	4	3	1	1.1	3	3	3	22.1
4: L + R (d) & (e)	3	4	2	1	3	3	3.5	3	22.5
	3	4	3	1	2.8	3	3.5	3	23.3
	2	3	2	1	2.5	3	2.5	2	18
	2	3	2	1	2.2	3	2.5	2	17.7
6: Ocean	2.5	4.5	1	1	1.9	2.5	3	4	20.4
	5	4	1	2	2.4	2.5	3.5	4	24.4

Day 1 - Summary

We have collectively:

- Been briefed by the Assessment Specialists
- Considered each option and the criteria assessment
- Considered the benefits/non benefits of weighting the criteria
- Agreed what you would like to see in day 2 for weighting sensitivity testing

Agenda for Day 2 – Trade off between the options

Weighting Sensitivity Testing
- Weighted option scoring results
- Lock in the weighting(if any)

Preferred Option(s)
- Can we shortlist a preferred option(s)?

Summary wrap up
- Option story

Next steps
- What further information do we need going forward

Close from the Mayor

PALMERSTON NORTH

NATURE CALLS

Wastewater BPO
Day 2

Collaborative MCA

9th & 10th November

Welcome from the Mayor

MCA – Workshop Agenda

Sara Dennis - Just Add Lime

5 mins

Agenda for Day 2 – Weighting & Trade off between the options

Determining the Weighting

Apply the Weighting

Weighting Sensitivity Testing

Preferred Option(s)

- Can we shortlist a preferred option(s)?

Next steps

- What further information do we need going forward

PALMERSTON NORTH
NATURE CALLS

Updated: Option Scoring Consolidation

Melaina Voss

XXXX

XXXX

PALMERSTON NORTH
NATURE CALLS

Assessment Criteria Weighting

Robert Van Bentum – Transport & Infrastructure Manager
Melaina Voss – BPO Project Manager
Jim Bradley – Stantec

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Weighting Process

The mechanics of the spread sheet

- The weighting must add up to 100%
- Xx
- Xx
- xx
- Live sensitivity testing

Group Work: Weighting Approach

Step 1

- Specialist Group - Determine weighting and then apply to Assessment criteria
- Council/Stakeholders – Determine weighting and then apply to Assessment criteria

Step 2

- Each group presents back rationale for weighting (why)
- Compare the Assessments and identify and discuss the differences

Step 3

- Agree on weighting

Step 4

- Apply the agreed weighting
- Apply the agreed weighting without Finance

Step 1: Determine Weighting and Apply

Specialist Group – Lead by Jim **45 mins**

- Determine weighting and then apply to Assessment criteria

Council/Stakeholder group – Lead by Melania **45 mins**

- Determine weighting and then apply to Assessment criteria

  - Two groups 15 mins each group
  - Come together as one group 30 mins discuss and agree weighting and the apply to the assessment criteria

Step 2: Rationale for Weighting (Why) and Comparing the Differences

Report back on rationale of weighting (Why)

- Specialist Group – Lead by Jim 10 mins
- Council/Stakeholder group – Lead by Robert 10 mins

Compare the Assessments

- Identify and discuss the differences – Lead by Melaina 10 mins

Morning Tea

Step 3: Consolidated Weighting

- Agree one set of consolidated weighting – Lead by Melania 15 mins

Step 4: Assessment Criteria Sensitivity Testing

- Apply the agreed weighting
- Apply the agreed weighting without Finance

Challenge

- For the criteria where there is **not** a score spread

    - What further information do we need?
    - It might be appropriate that some criteria are not differentiating criteria at this stage

PALMERSTON NORTH NATURE CALLS

Preferred Option(s)

HE TIROHANGA HOU KI TE WAI PARA | A FRESH LOOK AT HOW WE MANAGE WASTEWATER

Option(s) to take forward

- Top 2
- Top 3

Next Steps

XXXX

XXXX

Close from the Mayor

Lunch

XXX

XXXX

XXXX

XXXX

XXXX

Minutes of Meeting

PAPAIOEA PALMERSTON NORTH CITY

Wastewater BPO Short Listing Multi Criteria Assessment Workshop

Monday 9th and Tuesday 10th November 2020 at Palmerston North Convention Centre

DRAFT - Workshop Notes

Attendees	**Apologies**
PNCC Mayor and Councillors - Mayor Grant Smith, Councillors Brent Barrett, Karen Naylor (first day) Bruno Petrenas, Lew Findlay, Patrick Handcock, Renee Dingwall, Susan Baty, Vaughan Dennison, Zulfiqar Butt, Billy Meehan Chair of the PSG – David Warburton PNCC Staff – Robert van Bentum, Melaina Voss, Heather Shorter, Stuart McKinnon, Sheryl Bryant, Sacha Haskill Rangitāne o Manawatū – Danielle Harris, Peter, Jonathon Proctor, Muapoko - Robert Warrington Workshop Facilitator – Sara Dennis (Just Add Lime) Stantec – Jim Bradley (public health), Anna Bridgman (resilience, technology & infrastructure, financial), Paula Hunter (RMA Planning) PDP - Aslan Perwick (groundwater) Aquanet – Olivier Ausseil (freshwater quality and ecology) Keith Hammill (freshwater quality and ecology) Just Add Lime – Julie Boucher (social and community) Health Authorities - Brett Munro- Mid Central Public Health DHB, Dr Stephen Palmer Medical Officer Health (second day) Federated Farmers – Paul Olsen, James Stewart Water Protection Society – Chris Teo Sherell	David Murphy

Day One November 9th 2020
Item
Welcome Commenced with a Karakia Mayor and David Warburton welcomed everyone Sara Dennis (facilitator) outlined the workshop purpose - gain insight and shared understanding of option assessments, and programme for the day
Specialist Assessments
Commenced with an overview of the specialist assessments but not including scores.
Cultural overview – Danielle Harris • Paramount mauri of River, however there are issues with land application, • Reserve position if the final option does not add up for Rangitāne

Public Health – Jim Bradley, Brett Munro, Dr Stephen Palmer • Brett – don't want to fail again - referenced Havelock North • Jim- Importance of going forward with Public Health Authorities. Emphasised Brett and Stephen involved in the development of the methodology but not scoring. • Focussed on pathogens (germs), water supply protection, comparative qualitative public health risk assessment approach • Once have a preferred option will do a quantitative public health risk assessment • No published methodology in NZ for what we are doing • Taken a precautionary approach in looking at risk of options • Scale of public health effects and risk of exposure matrix developed for scoring, taken critical cases • Conceptual exposure pathways – land, water, air • MCA score based on number of critical pathways. Least critical number of pathways – scores best. Used a low to high scale with 1 the worst and 5 the best. • Assumptions - treated wastewater always within specification, not included wastewater operator exposure • Not looked at beneficial reuse options Q&A Chris Teo-Sherrell– If taking a precautionary approach why have you not considered high nitrate levels and the risk of bowel cancer? Jim Bradley – park this question and get Dr Stephen Palmer to respond tomorrow.
Natural Environment – Keith Hamill (freshwater quality and ecology), Aslan Perwick (land application and groundwater) Olivier Ausseil (freshwater quality and ecology, SIM model), David Cameron (marine waters) • Nutrient effects on River causing periphyton growth, effects on One Plan Targets - big focus on options achieving targets • Land discharges – leaching below root zone – depends on soil types, hydrology, lakes and small streams particularly sensitive. • Foxton estuary – river effects – low risk as high flushing • Groundwater – leaching rate compare with current land use, summer/winter difference, avoiding sensitive areas, applying buffer zones Q&A Peter??? – Any modelling of global warming, algal research Keith Hamill - no modelling of global warming but have taken this into consideration Brent Barret – differences in receiving environments – has there been an assessment of each of the receiving environments – Keith Hamill – yes, each expert did an assessment on the receiving environments, identified worst scoring out of coastal, river, land – generally the worst scoring environment was applied, the alternative was to average the scores for the three environments. Our preference was to take the worst score Bruno Petrenas – what was the SIM modelling Olivier Ausseil – in-house model with two parts - water quality module and periphyton module, periphyton harder to model, therefore use risk assessment tool. Model has been used for Feilding and Shannon. It has been enhanced for this project as incorporated site-specific data.
Māori Cultural Values – Danielle Harris and Jonathon Proctor • These are Rangitāne values – not speaking for other iwi • Semi qualitative assessment • Cultural values, cultural landscaped, atua, potential acceptance of our people • Fundamental is the protection of the mana of river, looking after our own waste activities contained within our rohe, the river has done enough for the City • Scoring, 1 = destruction of Rangitāne culture and connections with kaitiakitanga • The coast and its resource should not be impacted on or threatened • Made an error in options developed – treatment aspiration to achieve drinking water standards – aspirational with a longer term vision

<u>Q&A</u>
David Warburton – is there a significant difference in Rangitāne's view and that of other iwi?
Danielle Harris -Expect they are aligned with our thinking, but they may have identified other options Jonathon Proctor - ensuring solution retained within Rangitāne rohe should address issues
Mayor – coast option not on table, 80% of NZ's discharges are to the coast, why is it the least preferred option?
Jonathon Proctor - two main issues - last untouched bastion, especially for gathering food. The coast is going to be tested with fisheries issues not known to council and planners
Danielle Harris – the coast has also been impacted
Mayor – keeping within rohe – is this possible?
Jonathon – tough call to stay withing rohe, there is some wriggle room in some of the options.

Social and Community Considerations – Julie Boucher

- Complex assessment – it is about people and you need to talk to people, relying on outputs from public engagement to date, not dependent on specific location - geographically agnostic, used accepted methodology built on international social impact assessment guidelines
- Social acceptance is very subjective – different approaches for different people / communities
- Developed sub criteria
  1) gravity highest impact on public health, infringement in access to basic life necessities, ecosystem services, managing impact within area or outside
  2) need for land acquisition and degree of permanence of land use change
  3) public support for option

<u>Q&A</u>
Zulfiqar Butt – concerned about your scoring of the sub-options being opposite to the scoring for the overall options
Chris T?? – public support all withing 25%, scores very narrow band
Julie Boucher – we had to split it somehow, tried not to weight the sub criteria
Chris T?? – further investigations will not be undertaken until there is a preferred option – concerned you don't have geographical footprints
Julie Boucher – we have information on potential locations, but we were instructed not to use it at this stage. We can go back and include this information in our assessments
Bruno Petrenas – what about the social impact of increased rates
Julie Boucher – this is an economic matter and one that Council should consider
Brent Barrett – public support – why looking at support rather than antagonistic position – not a lot of specific feedback around specific options to give this a really strong score
Karen Naylor – Given that a score of 1 is the least desirable and 5 is the winner I am confused about the sub criteria scores being the reverse – need to swap the numbers around to match the scoring for this project.
Julie Boucher – we can do that.

Resilience – Anna Bridgman, Jim Bradley, Aslan Perwick, Peter Brown

- 2 categories for resilience – natural hazards, and climate change and adaptation
- Natural hazards includes – earthquakes, erosion and land movement, flooding, sunami
- Climate change includes wet weather events, dry periods, sea level rise, storm surge
- Looked at both criteria individually and averaged scores – neither had stronger effect than other so averaged

<u>Q&A</u>
Robert van Bentum – explain how each of the receiving environments assessed
Anna Bridgman – for example in the coastal environment storm surge, sunami and forest fires
Zulfigar Butt – why were earthquakes all treated equally for all options
Anna Bridgman - WWTP, pipelines, built to code, longer pipelines requiring more pipeline compared to shorter pipelines.
Chris Teo-Sherell – taking average score compared to public health approach of worst score. Would it be sensible to give worst score- if fails it fails

Anna Bridgman – considered a range of components for each scheme and there was not much variation
Robert van Bentum – natural hazards relates to an event and climate change is adapting over time e.g. longer drier summers more intense rainfall events specific impact on land
Aslan Perwick – crop resilience impacts on amount of treated wastewater storage required, can lift dams up, need to determine what is the risk can it be managed, if floods effect inland schemes can they be moved off the flood plain, captured whole range of scenarios.
Anna Bridgman - outfall designed to deal with sea level rise.
Jim Bradley - operational resilience is addressed in infrastructure category
Chris Teo-Sherell – outfall on seabed, resilience scoring takes into account what you do to design for climate change conditions
Anna Bridgman – outfall partially buried - designed to address storm surge

---

Growth and Economic Development – Melaina Voss, Richard Peterson

- Used a 35 year consent duration, 50 years asset life and moderate growth rate, also considered how well an option could be adapted to a sub-regional scheme - ability to accommodate other territorial authorities' wastewater – quantity and loads
- Assimilative capacity of receiving environment – relied on work done to date
- Have not identified geographic areas
- Low score – deteriorates economic growth, does not meet growth target, unable to take other territorial authorities' wastewater
- High score – promotes economic growth, take on changes in land use, supports taking on other territorial authorities' wastewater as a sub-regional scheme

<u>Q&A</u>
Vaughan Dennison – limited ability to accept future wet industry
Melaina Voss – we made the assumption that Council would not allow significant increases in wet industry
Vaughan Dennison – med population growth at 1.2% pa
Melaina Voss – we adopted growth projections used in Council's strategic planning documents
Vaughan Dennison - next 10 years looking at upper to high growth projections
Susan Baty – we need to agree base especially looking 35 years out
Robert van Bentum – we have actual flows and loads and then project a number of envelopes including some wet industry and trade waste. Full exploitation of zoned land, key thing to ask – what happens if we need more which options give us the flexibility to accommodate this.
David Warburton – wet industry projections allowing for high and average – pre-treatment before discharge into PNCCs system
David Warburton - did you consider options for land uses
Melaina Voss – we considered at a high-level forestry and cut and carry
Brent Barret – for land discharges did you look at the economic impact changed land use
Melaina Voss – we looked at creating revenue and loss of a farming activity
Brent Barret- did you consider rural access to irrigation
Melaina Voss – meeting with farming community to understand effects

---

Technology and Infrastructure – Anna Bridgman, Aslan Perwick, Jim Bradley

- Adopted six sub criteria
  1) Whether the option can be staged
  2) Whether the option can be constructed and operational within 5 years of granting consent assumed land would be acquired within 5 years – this was discussed with the Property Group
  3) Ability for resource recovery and beneficial reuse
  4) Whether infrastructure can be upscaled to accommodate sub-regional scheme – only considered infrastructure not receiving environments
  5) Operational complexity
  6) Operational risk
- Scored sub-options 1-4 in terms of alignment, and sub-options 5 and 6in terms of risk
- We averaged the scores

<u>Q&A</u>
Lew Findlay – if land to be purchased in 5 years – have you identified land
Anna Bridgman – no we have not identified land parcels for the land options
Melaina Voss – we have looked at soil types – fluvial (loam) inland soils and sandy coastal soils
Lew Findlay - this whole area very liquefaction prone has allowance been made for this
Anna Bridgman – this factor was considered under resilience
Vaughan Dennison – consideration of the effect on the mana PNCC due to the scale of land required Public Works Act
Melaina Voss – there are a range of mechanisms that can be used to acquire the use of the land – not just the Public Works Act. There could be willing sellers – this will be investigated once areas are identified.
Patrick Handcock – need to be able to keep growing infrastructure - want to build for the future
Anna Bridgman – ability to stage options was considered - stage pipelines to meet capacity, enable improvements to treatment to be made
David Warburton – if go too big too early leads to problems in operation
Robert van Bentum - some receiving environments have limitations also have to pay for that. If build infrastructure that is significantly larger Council can't immediately charge for it e.g. trade waste allowance, so domestic ratepayers will carry these costs

Financial Implications – Anna Bridgman, Rita Whitfield

- Undertook high level cost estimates for each component of the options
- Developed in conjunction with environmental team to ensure any require environmental limits were met
- Assessed capital and operation and maintenance cost and included large contingencies. Whole of life and net present value (NPV) over 35 years, 6% discount rate
- Capital was the most significant cost - capital 37%, operation and maintenance 30% net present value 33%
- Highest cost any option was scored a 1
- Assumed an annual return for inland sites(cut and carry) and a 28 year return for coastal sites for forestry

<u>Q&A</u>
Chris Teo-Sherell – capital and operation and maintenance weighted separately but they all have to be borne by ratepayer
Robert van Bentum – this methodology is widely used. Different options around capital. Operation and maintenance consequential costs now for current ratepayers
Anna Bridgman - borrowing for capital and operation and maintenance costs range $3-4m pa over 35 year period
Karen Naylor – range of ranking quite narrow in terms of scores - 0.1 and 0.2 difference – why not spread across the range.
Robert van Bentum – we can address this in the weighting.
Karen Naylor – what would it have taken to get a score of 5
Anna Bridgman - we knocked out extremes on the long list assessment
Jim Bradley – the status quo would get a score of 5
Patrick Handcock – the operation and maintenance costs variance what is the difference between the river and outfall.
Anna Bridgman it comes down to the size of infrastructure to be operated for the river $8m and the outfall 5m
David Warburton – need to consider both capital and operating costs from a practical financing point of view
Patrick Handcock - Mitigations for harming environment lesser levels of treatment comparing river and outfall
Anna Bridgman – yes the level of treatment is less for the ocean outfall than the river
Stuart McKinnon – some capital costs we can afford and some we can't – can't borrow $500m.
David Warburton - this is where relative weightings apply.
Karen Naylor – impact to land owners
Lew Findlay – 11-12% of our rate payers are on fixed incomes, how are they going to pay for this

Robert van Bentum – we have already fatally flawed some options because of cost. Are there other options that should be fatal flaws around affordability.
Mayor – we need to go through process first before we fatally flaw options further - we might have some funding partners – industry, government,

National Context – Mayor

- Some people are asking why we are going through this process with the government reforms on Three Waters happening
- This is valuable work and it will not be wasted.

David Warburton - this could become an exemplar in terms of the process Council has adopted – opportunity to gain a lot of benefits. Keep on with enthusiasm to do a really good job.

Option Assessments

Option 1 – River Discharge with Enhanced Treatment
Description – Robert van Bentum

- Fine filter through membrane bioreactor technology
- Percentage reduction in the river that relates to PNCC's proportion of nutrients removed
- Cannot guarantee periphyton limits of the One Plan can be met
- Smallest land portion (470ha) – 10% of total discharge during river low flow periods
- Takes the most nutrients out of the environment
- Nitrate levels below drinking water standards
- Includes a wetland

Attendees broke into groups to discuss scores attributed to Option 1 by each specialist
Discussion
Patrick Handcock – can the process accommodate further enhancements in the future, does it allow for even a higher level of treatment
Jim Bradley – yes, there are further treatment enhancements – reverse osmosis which was fatally flawed in the long list because of costs.
Jim Bradley – The options involving discharges to land should they have a higher resilience score as could continue to discharge to land if there was a malfunction at the wastewater treatment plant.
Anna Bridgman – land based schemes have flooding risks, assumed they would be located in a floodplain, exceed hydraulic loading – less resilient overall. Longer the pipelines more things to manage.
Peter (Rangitane) – effect of the treatment system on DNA
Jim Bradley – treatment process includes biological treatment, microfiltration, DNA will either be biologically transformed, removed with particulate matter of stays in the treated wastewater column.
Chris Teo-Sherell – are the differences in the public health scores due to the mitigation put in place for land treatment e.g. buffers, access restrictions
Jim Bradley – went through all pathways – added up critical pathways – could change 2.5 to a 3
Chris Teo-Sherell - is the level of treatment the same for land as for the river?
Jim Bradley – yes
Aslan Perwick – but the land result in additional removal of nitrogen
Vaughn – the cultural value scores don't give any recognition to the land component. Isn't there a compensatory benefit given the discharge is taken out of the river at low flows?
Danielle Harris – the land is only a minor component
Vaughan Dennison – do the social scores reflect the size of land footprint required? Bigger the footprint the bigger the impact
Julie Boucher – no, the score do not reflect the size of the footprints – hard to assess as depends on land uses – if discharging to a forest potentially no impact but if discharging to productive land could be a big impact
Vaughan Dennison – why the differences in the public health scores
Jim Bradley – public health scores for the plus land option look a bit harsh in comparison to some other options when you take the enhanced treatment into account and the treatment provided by land – based on the number of critical pathways – comfortable to change from a score of 2.5 to a 3

Option 2 – Two river discharges + land
Description – Robert van Bentum
- Avoid discharges at Totara Road during lower river flows below median
- This avoids impact on stony bottom of river
- Benefit – don't have to invest in very high levels nitrogen removal.
- Involves discharges to two wetlands. Totara Road much smaller, but much larger wetland at Opiki.
- Discharge close to Palmerston North

Attendees broke into groups to discuss scores attributed to Option 2 by each specialist
Discussion
Patrick – when comparing the public health score for Options 1 and 2, why have both options scored 4 when Option 2 has a lesser level of treatment
Jim Bradley - not discharging from Totara Road at low river levels, moving discharge to Opiki - measuring number of critical pathways. In comparison with option 1 reduce Option 2 public health score from a 4 to 3.5
Olivier Ausseil - the discharge at Opiki avoids river gravels, periphyton risk is lower, other issues to be considered although treatment levels are not as high. Scored better that Option 1 but very little difference
Robert van Bentum – the scoring is based on how well the One Plan targets are met.
Olivier Ausseil - Totara Road pushing nitrogen levels but includes a land component, three receiving environments Totara Road, Opiki in the lower Manawatu and the estuary. Doesn't change situation with estuary. Totara Road taking discharge out over median flow and going to land. Level of certainty greater here than for Option 1
Vaughn Dennison – is the difference in nitrogen going from 2mg/l for Option 1 to 35mg/l for Option 2
Keith Hamill – the Totara Road location is very good at growing periphyton, hence very low nitrogen limit.
Susan Baty – question the social score because it does not consider number of communities affected.
Anna Bridgman - Infrastructure scored a 3 for this option because there is a high element of potential resource recovery, scores lower for upscaling for a sub-regional scheme can address this from a treatment perspective but not from an infrastructure perspective

Option 3 - 97% discharge to land
Description – Robert van Bentum
- Upgraded treatment 35mg/l of nitrogen to 10mg/l of nitrogen because on the coastal soils the 35mg/l requires an extensive amount of land.
- Requires large pipelines, storage areas, lots of pump stations.
- Will involve a constant discharge.
- Two options - inland discharge, coastal discharge.
- Even if there is a higher level treatment already optimised hydraulic limits for the sites

Attendees broke into groups to discuss scores attributed to Option 2 by each specialist
Discussion
Aslan Perwick – the inland site driven by effects on ground water, the coastal effects are on coastal streams and lakes, 21-25kg/ha/year leaching targets, need to get them to a level that will be acceptable for receiving environment. Not ideal inland soils – will not require irrigation in winter – this is manageable but not ideal – washing nutrients through.
Chris Teo-Sherrell- if 97% driving negative outcomes what about 80-70% - is this a linear thing.
Aslan Perwick - once get into wet months really want to get off those soils – significantly better improvements with other options. Winter leaching, but in the summer heaps of uptake. We have got around leaching issue through the treatment.
Robert van Bentum – what sort of uptake of the wastewater.
Aslan Perwick - 50ml/month
David Warburton – what if nitrogen was at 10mg/l on inland soils
Aslan Perwick – it is the hydraulic loading that govern this

Chris Teo-Sherrell– It would be very useful to have information on what is impact would be on the scores if cut off point to go to river is changed to e.g. 80%, 75% etc. of the time
Vaughn Dennison – what are the financial implications of coastal areas versus inland areas – are there other options around financial modelling
Mayor – with growth and economy what are the potential loss of jobs with farming land use change. PNCC's reputation could be challenged by farming community – should the scores be higher for coastal areas but lower for the inland areas?
Mayor – would this be the largest land application scheme in New Zealand?
Jim Bradley – yes, Taupo is currently the largest scheme at 500ha
Melaina Voss – the scoring also considered the ability to adapt to a sub-regional scheme
Susan Baty - all the score sitting in middle
Robert van Bentum - this is where the weighting comes in

Option 4 - 45-55% to land
Description – Robert van Bentum

- No Increase in treatment other than optimisation
- Nitrogen at 35mg/l

Discussion
Aslan Perwick – this option did not score well from an environment perspective because of effects on coastal lakes and streams, soils less effective removing nutrients
Jim Bradley in terms of public health - inland areas only 5 critical pathways, coastal areas have 8 critical pathways because of shellfish and coastal lakes and streams
Chris Teo-Sherrell – what are the implications of the differences in treatment between option 3a and 4
Jim Bradley – Options 3a and 4e on inland soils have nitrogen at 10mg/l and 35mg/l for Option 4d. This is based on land being cheaper than further treatment
Patrick Handcock – the differences in land costs – the cost of the coastal seems too low. What are the differences in income between cut and carry and forestry?
Aslan Perwick - $2,000/ha/year for inland soils (cut and carry) and $1,200ha/year for forestry

Option 6 – Ocean Discharge
Description – Robert van Bentum

- Outfall offshore indicative 2km in length
- Two options one with land discharge in summer and one without land, 50% average dry weather flow to land in summer
- No Increase in treatment other than optimisation and no alum dosing for phosphorous removal

Discussion
Chris Teo-Sherrell – what is the benefit of including land?
Jim Bradley – the environmental benefit is limited, could be commercial benefit if it involves the right land use, but costs associated with land purchase
Keith Hamill – this option good from an environmental perspective, potential land effects good as only a small area of land required and in summer taking out nutrients. Because of the small area of land required able to avoid sensitive lakes.
Jim Bradley – in terms of public health the option without the land component scored a 5 because it had the least critical pathways. The land component could be a dilemma depending on where it is located. Happy to increase 2.5 to 3 based on further comparison with other option scores
Brett Munro - get confirmation from Stephen
Chris Teo-Sherrell – what are the differences between Option 1 score change and Option 6 change
Jim Bradley - Option 1 has higher quality treatment
Aslan Perwick – question the public health score for land component – the discharge is half the flow half the year, smaller land area can avoid stream and lake catchments, very difficult to get to these streams and lakes, need to explore how many people are potentially gathering watercress.
Jim Bradley – agree to raise public health score from a 2.5 to a 3 based on Aslan's reasoning
Keith Hamill - ocean discharge low risk on aquatic life primarily because of the length of the outfall – 2km offshore, involves some nitrogen removal as diverting half the flow to land in the summer.
Keith Hamill - not sure if the 0.5 difference is justified. Very close scores

Melaina Voss – for growth and economics this option had a high score because most acceptable for a sub-regional scheme. Robert van Bentum – for sub regional schemes the treatment does not have to all be at Totora Road, could be Feilding etc. with agreements to meet particular standards.
General discussion on overall scores, additional information and 'parking lot' list Robert van Bentum - cores very close, not much difference between the options Chris Teo-Sherrell – taking a precautionary approach to public health – but what about bowel cancer risk with high nitrates? Jim Bradley – will get Dr Stephen Palmer to talk about this in the morning Chris Teo-Sherrell - did the environmental assessments address effects climate change - did modelling look at changing nature of flows. Olivier Ausseil - modelling is based on historic assessments that looks back 10 years. Synthetic assessments done for land – didn't make much difference as getting drier and wetter. Modelling not queried in Feilding case Chris Teo-Sherrell – why taking lowest score for the environmental assessments Keith Hamill – could go to an average score for three environments as could offer more nuances. Susan Baty – for the social and community scores – need to relook at triggers, reorder to reflect adopted scoring Brent Barrett – need more clarity around growth projections and whether an option provides for higher growth than anticipated. Patrick Handcock - questions over the land costs, Council's debt limit, acceptability of land use change, ability to secure land Jim Bradley - value of residual assets – can pass land asset on unlike a pipeline Vaughn Dennison - under pitching how we acquire land – forgone conclusions that we are going to get this. Comes with consequences – reputational risk, issue is scale 500ha vs 3,000ha. Council needs to consider its reputation - need to unpack this further David Warburton - fundamental issues how procurement managed and commercial arrangements. Need recheck land values, coastal may be too low. Karen Naylor - financials ranges need to be addressed, the bands are too narrow and there are big numbers involved Patrick Handcock - what we can acquire needs to be possible Chris Teo-Sherrell – need to investigate lowering thresholds on discharges to land 97% to 85%, 80% etc. consequences for social, economic, cost David Warburton separate out the difference between BPO from financial point of view. Anna has assessed technical costs. Need a second conversation around procurement and how it comes affordable – separate exercise – how much it costs and who pays. Brent Barrett – need to assess social high level of opposition as well as high level of support

Agreed changes to scores and further investigations
1) Change the public health score for Option 1 from 2.5 to 3 for the following reasons:
    a. Same level of treatment for the wastewater going to the river and to land
    b. Increase in risk pathways negligible
    c. During dry weather leaching potential is much lower
2) Change the public health score for Option 2 from 4 to 3.5 for the following reasons:
    a. Comparison with option 1 as less degree of treatment
3) Change the public health score for Option 6a from 2.5 to 3 for the following reasons:
    a. Land area is small
    b. Only applied to land six (drier) months of the year
4) Revisit the social and community scores to:
    a. Take into account the land areas required and make assumptions about potential land uses in comparing the coastal areas and the inland areas
    b. Align scoring of sub-criteria with overall scoring approach
    c. Consider public opposition as well as support
5) Resilience score for infrastructure for Option 1 could be a bit extreme – Anna Bridgman to consider changing the score from a 4 to a 3.5
6) Dr Stephen Palmer to address bowel cancer risks associated with high nitrate levels

7) Rerun the environmental scores base on an average score rather than the lowest score 8) Check growth projections 9) Check land cost estimates, especially for coastal areas 10) Revisit the cost groupings to try and achieve greater differentiation of scores 11) PNCC to consider procurement, affordability as a separate exercise 12) Investigate lowering thresholds on discharges to land 97% to 85%, 80% etc.
Day Two November 10th 2020
Commenced with a Karakia Sara Dennis (facilitator) outlined the programme for the day
Presentation by Medical Officer of Health - Dr Stephen Palmer
Stephen Palmer - need to consider wider determinants of health – while focussed on public health also interested in the wider aspects, particularly equity – providing more to those in need compared to equality and Maori Health – much wider view than just physical Mason Dury Model – healthy environments. <u>Q&A</u> Bowel cancer issue and high nitrate levels Stephen Palmer – this is a different risk profile, we have been assessing pathogens – one dose and you get effects. Also have blue baby syndrome caused by drinking water contaminated with nitrates. The colon rectal cancer issue is about long-term effects Colon rectal cancer – long way from ascertaining causality - very long-term effects, many, many people drinking water with nitrates. Would not factor this into any public health risk assessment. Lot of carcinogens get removed from the wastewater through treatment process.
Further discussion on scores
Julie Boucher – revised social and community scores over night to take into account the land areas required Brent Barrett - how much is based on the actual consultation Julie Boucher - not weighted sub criteria - grouped options that were preferred James Stewart - biggest issue for farmers is use of plastic for bailing – cut and carry land use – have you taken into account public perception of this for the cut and carry options. Julie Boucher - have not taken this into consideration at this stage Brent Barrett - feedback from consultation - quite a lot of differences. Concerned taking a slice of community inputs, impact on farming community, unwilling sellers – concerned introducing a lens that could be the inverse Robert van Bentum - natural environment score used the lowest score for each of the receiving environments rather than an average score – is that appropriate? Keith Hamill – this is a question for the group how much importance do you want to place on the river, groundwater, coastal waters Mayor - if all options had same level of treatment, they would be easier to test Robert van Bentum – we have developed the treatment levels of the options depending of achieving receiving environment targets. Mayor - why can’t we do better than just meeting targets – this is a long term solution and targets may change Robert van Bentum – it all comes down to cost and what is affordable. Peter (Rangitane) – the public perception is that there is a greater advantage to do better especially from ecological and Māori point of view • Decision by the workshop attendees to keep lowest score approach for the environment Chris Teo-Sherrell – in terms of public health it is assumed there would be no adverse human health effects from whatever option chosen – should there be different scores, should the scores be all the same? Stephen Palmer – the original assessments all came out the same but we then looked at the ability to manage risk.

Jim Bradley - looked the number of critical public health risks and different pathways to manage risk.
Robert van Bentum – more pathways, more environments more opportunities for failures
Aslan Perwick – question Option 6a public health score and whether it should be a 3.5 or a 4 – up to Jim and Stephen to discuss
Anna Bridgman – agreed to change the resilience for infrastructure for Option 1 from 4 to 3.5

Changes to scores, decisions, and actions

1) Include updated social and community scores
2) Retain lowest score approach for the natural environment assessments
3) Confirmed public health score for Option 6a (land component) as 3
4) Change the resilience for infrastructure for Option 1 from 4 to 3.5 for the following reasons:
    a. Option 1(b)

Weighting

Introduction
Robert van Bentum - weighting must add up to 100%
David Warburton – consider the weighting on the impact on project – the importance of the criteria. There is also a weighting on level of confidence of the information provided
Jonathon Proctor – the weighting on the confidence of the information is very important
Councillors and stakeholders broke into two groups to consider weighting of criteria. Considered a weighting with finance and without finance
Specialists did a separate weighting exercise, but only considered weighting without finance

Councillor and stakeholder weighting discussion
Group 1 – Mayor – report back
Weighting with finance – key responsibility of councils is public health - needed a high rating, natural environment and resilience very important because RMA dictates this, cultural values have highest score, social disruption a concern, technology and infrastructure a consequence so no weighting, growth relatively high as must provide for growth
Weighting without finance pared back public health and Natural environment
Group 2 – Councillor Baty – report back
Weighting with finance - had differences in group – wanted public health taken out as it is a given, decided to take a low med and high approach and this is probably why ended up pretty middle of road
Weighting without finance - just recalculated

Specialist weighting discussion
Jim Bradley – report back –
Weighted public health, natural environment, Māori cultural values, and social and community all with 20%, issues with double counting if consider public health in a wider context
Double counting e.g. wider picture of public health, assumed technology is proven, resilience is an unknown,
social and community based on level of importance, not confidence
Degree of confidence in the information and data assessed as – public health 50%, natural environment 70%, Māori cultural values 60%, social and community 20%, infrastructure and technology 80%, resilience 50%, and growth and economy 30%

Combined weighting discussion
David Warburton – some criteria that are outcomes and some that are consequences e.g. natural environment determine resilience and infrastructure and technology is an outcome – design to meet natural environment outcomes.
<u>Issues</u>

- Double counting e.g. Māori cultural values considered in public health and natural environment
- If address equity issue, then Māori cultural values should have the highest weighting
- How to reconcile importance of criteria with confidence in data e.g. lack of data for social and community

- If assume public health is a given for each option then it should have a lower weighting, could make this assumption also for infrastructure and technology
- Should outcome criteria be weighted higher than consequence criteria

David Warburton – let's sit with this at moment but run different scenarios and see what happens
<u>Combined scores without finance</u>
Mayor - Councillors have a different view on social and community weighting because of lack of data, specialist group weighting is higher because it is based on importance. Infrastructure and technology criterion is a consequence therefore councillors weighted it 0%, specialist group weighting 5% so on same wave length
Robert van Bentum - scores similar to raw score
<u>Combined scores with finance</u>
Robert van Bentum - most expensive option ranked second
Patrick Handcock- financial range needs to be recalibrated so there is a wider range. By changing finance weighting only taking away from other criteria – the scale is skewing
Olivier Ausseil - if want to see financial coming through more strongly need to change the scale
Brent Barrett – everything has been compressed because of fatal flawing
<u>Scenarios and ranking approaches</u>
Keith Hamill – proposed to rank the order options from 1 to 11 and standardises all the scales
David Warburton – if you take finance out it becomes a secondary discussion. Identify options without finance and then consider them in terms of affordability
Robert van Bentum - ocean discharge consistently coming first
Jonathon Proctor - not enough information on the local marine conditions, applied high level understanding
Peter (Rangitane) - because outfall coming at top need to do more investigations into local conditions Robert van Bentum - not picking one option – looking for the options that come through to top.
Stephen Palmer - increase Māori cultural values to 40% - without finance makes a difference 97% to land #1, ocean option changes to #4
Brent Barrett – increase social and finance to 40% because the ratepayer of Palmerston North are going to pay for this - Option 1 #2, Ocean outfall #1, Dual River #3
Robert van Bentum – we will write a paper for you on the various weightings and scenario testing done today.
Paula Hunter – we will also include an RMA Part 2 weighting as this required by case law.
David Warburton – we have an envelope of weighting differences – 4 common options
Robert van Bentum - more work required – local marine environment, land acquisition and use, RMA Part 2 weighting and work identified from yesterday.
Melaina Voss – Council is clear on option(s) before we go back to the community
David Warburton – gut reaction why is the ocean option with some land not coming through – this is a practical mix and match
Patrick Handcock – some of land options don't feel right – don't think you have number landowners right
Aslan Perwick – surprised how the river discharges with high treatment not coming through – other projects been involved with most capital going into treatment – do you want to put capital into pipeline rather than treatment.
Robert van Bentum - not rivers per se, but unique situation with the Manawatū River.
Olivier Ausseil – potential for some options to be progressively implemented – could achieve river outcome with option R2
Robert van Benton - we can revisit criteria e.g. natural environment based on One Plan targets, financial with an extend the range. We can pull this together in next couple of weeks
Melaina Voss – need to take stock of where we have got to in terms of the outputs from yesterday and today. We will prepare a paper for PSG on where we have got to and look at Octopus diagram to determine what other works is required. We also have a process underway with other iwi and the outcomes from this need to feed in.

Closing
The Mayor and David Warburton thanked everyone for attending the workshop and all their contributions

Closed with a Karakia
Further investigations from Day Two 1) Recalibration of the financial range so there is a wider range of scores 2) Assessment of local marine conditions for outfall option 3) Prepare a paper on the various weightings and scenario testing undertaken on day two 4) Include a RMA Part 2 weighting 5) Revisit the criteria including adoption the One Plan targets for the natural environment 6) Consider the potential for some options to be progressively implemented 7) Prepare a paper for the PSG on workshop outcome paper for PSG in conjunction with the Octopus diagram to determine what other work is required

Workshop Closed: 12pm Tuesday 10th November 2020